THE

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THE

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THE SHIFTING SITE OF NATIONAL INDUSTRIAL SUPREMACY.

THE aspects of national industrial supremacy in the iron trade have been ably dealt with of late in the *Engineering Magazine* by Mr. Jeans, who now again writes under the above title, and argues the question of cheap and dear labour. Mr. Jeans has left over this article until he could, in some measure, estimate the result of the strike, and he is optimistic on the prospect. He endorses our already expressed opinion, that if the result of the strike be to put a stop to the bad and dishonest conditions which have been prevailing, there is much brighter prospect for British industry. Great Britain, says Mr. Jeans, has suffered more loss of prestige to her industrial character from the bad side of trades unionism than from any other cause. Mr. Jeans has otherwise a high estimate of British labour—its skill, doggedness and capacity to produce good work, and no Englishman need be afraid of comparison with Continental products.

A factor in industrial supremacy is a large home demand. This it is has built up trade for the United States. Home demand brings works into existence, and these expand, and finally are able to produce for outside. The absence of home trade has kept unprogressive countries in a backward condition as regards metallurgy. For example, take Russia, with a population in 1880 of 100 millions, and a pig-iron manufacture of only 465,000 tons, of finished iron 292,000, and of steel 307,000, whereas undeveloped America produced four million tons of pig and three million of finished, or partly finished, products. America was progressive, and has now obtained the first place in iron production, though still second in production per head of population, and very low down in production per area. Mr. Jeans is of opinion, and he claims that his opinion is based on experience, that no country possesses such resources as to give it a supremacy in so widely diffused an industry as iron and steel making for a very long time. The ore and coal deposits of New South Wales are so great as to afford the expectation of production as cheaply as in any other country. Then there are the resources of British India, of China, Siberia, Japan. In India especially the coal and iron resources are great and are widely spread. In Spain there are good prospects, and the newer Spanish ironworks are well equipped, and there are the conditions in embryo that would enable pig to be made as low as 28s. per ton—practically the cheapest price in Europe. Russia is now progressing, and the demand in Siberia may become great now that railway facilities are provided. The total iron production of the world, which was not five million tons in 1850, grew to 12 million tons in 1870, and then in 1880 to 18, and now to 32 millions. It will be 46 millions in 1916, and 60 millions in the lifetime of most

young engineers now living, if the present rate of growth be continued.

Where can anyone at present see the source of the extra 50 million tons of ore to provide for the demand in 36 years hence? Great Britain certainly cannot hope to do more than put out her present annual 15 millions of tons. Germany is in no better case. France has stuck for many years at 3½ millions, despite the large deposits of the Meurthe-et-Moselle district. That country, apparently, must be first which can put out the biggest weight of ore. But it is not materials alone which tell. Much depends on the character of the people. A skilled and industrious population is necessary, such as found in Great Britain or the United States, and rarely in semi-civilised countries like Russia, or in fallen-back nations like Spain. The unquestioned efficiency of the British workman—when he chooses—may in the future be found allied with the willingness of the American, and show itself in the running of plant for all it is worth. If so, the change will greatly modify the present conditions. In the best American works it may be assumed there is now little or no reserve of force. In Great Britain we have a reserve of *30 to 60 per cent.*—the italics are ours.

If Mr. Jeans be right, and he only voices our own ideas, the geographical and climatic advantages of Great Britain must tell powerfully in the future as in the past. Already a few of our leading works, Barrow, Dowlais, Bolckow, Vaughan & Co., now compare favourably with any in America as to costs, and the old country has plenty of "kick" still left, and one of the surprises of the future may be a resurrection of British supremacy on a scale quite undreamed of. John Bull is so very pessimistic—he does not magnify his powers or achievements, and when it is considered that Great Britain has everything but ores, and they can be so readily and cheaply imported, it is unlikely that she will suffer eclipse.

Lately, conditions have not been fair. Germany and America have kept up home prices by pools and syndicates, and dumped surplus production into neutral markets at prices only possible under the pooling conditions at home. In fact, the German and American public have been really presenting iron to foreigners in the way France and Germany present sugar.

The near future, probably everywhere, will bring the legislative cost of production a little higher. Already this is 1s. 3d. to 1s. 6d. per ton in England, and it is considerable in Germany. It is likely to increase in America as greater care of life increases. The United States also are not likely to be so free of war burdens, or Europe maybe will drop some of her crushing load by federation. With a quarrelsome America the Continent of Europe might find it necessary to federate for its existence, and America has already evinced strong desires to go outside her own territory and drop the Munroe doctrine of non-meddlesomeness.

The present Spanish imbroglio seems likely to result in heavy war expenditure in America, demanding taxes which will even up costs of production and place American industry under charges more approaching to those borne by others. Such would seem to be the outcome of the note struck by Mr. Jeans in his article, for already he states few of the leading American works have been of late making large profits. One notable exception remains, which we take to be the Carnegie Company, and this has made handsome profits on account of efficiency of administration and singleness of purpose rarely equalled in manufacturing annals.

The Belleville Boiler at Sea.

At the time of the much lauded trials of H.M.S. *Powerful* we ventured to doubt the propriety of such an expensive and serious experiment. Hints as to the fearsome coal consumption of this fine ship do not tend to re-assure us. A paper just presented to the Institution of Engineers and Shipbuilders of Scotland by a Russian engineer detailing his experience on board the ss. *Kherson* adds further testimony to the inadequacy of the circulation in Belleville boilers. In the *Kherson* there are 24 boilers placed back to back athwartships—this position, to our mind, being specially suited to put a check on proper circulation. In each boiler are eight elements of 20 4½-inch tubes each, the lowest tubes ⅜-inch, the two next $\frac{5}{16}$, and the top two rows ¼ thick. When first tried the port side boilers did not work so well as those on the starboard, the bottom box joints to feed collectors leaking. When the trial was over it was found the ship listed 10½° to the starboard. At a second mooring trial the list was 5° and reversed, and the same faults were repeated, but also on the opposite side, and the faults were less pronounced, owing, perhaps, to less list and a shorter run. The faults developed consisted of the bending down of the tubes from 1 inch to 1½ inches. Throughout the voyage faults always occurred on the side opposite to that towards which the ship listed, and a point of peculiar interest was that previously bent tubes tended to become straight, and some even bent upwards, as, indeed, is the normal tendency of the lower tubes of Belleville boilers. Mr. Gretchin attributes, we think rightly, the trouble to the list causing the odd rows of tubes to become horizontal if the list is 2½°, and to incline the wrong way when the list exceeds this amount. Mr. Gretchin's experience points to the need of very skilful firing of fires 3 to 4 inches thick, and he details the system of routine working, continuous repairs at sea and in port, and, altogether, his paper is lively reading for anyone who knows even a little of life at sea, and can picture the succession of bent tubes, leaks, split welds, the rattling of non-return valves as the ship rolled as if to prove the need of these in the mud boxes. Nothing that has yet come to light concerning the Belleville boiler has tended to re-assure us as to its suitability for steam raising in defence of the empire.

Permanent Indicator Rigs.—The *Street Railway Review* describes a convenient permanent indicator rigging which gives a thoroughly perfect movement. It consists of a shaft parallel with the piston rod, and supported in bearings bolted to the underside of the upper guide. The shaft is sufficiently to one side to clear the crosshead, yet close to the guide frame, to allow free access to the gland, &c. To the shaft is fixed a brass strip, so curved as to form a portion of a high pitched helix. This is engaged by a fork belted to the crosshead. The fork carries rollers. A movement of the crosshead of 60 inches gives the shaft, by engagement of the fork and helix, a rotation of something less than 60°. Motion is carried by means of cranks and connecting rod from the shaft to a second shaft, carried in brackets on the side of the cylinder. Small cord wheels on this second shaft carry the cords to the paper barrel. We think we have somewhere seen a similar arrangement carried out by means of a slightly twisted square bar, such as is used in the valve gear of a fire engine. Any device to be successful at high speeds needs to provide for the shortest possible cords, and should be of great rigidity compared with its weight, or at least its moment.

"FREE" AND "EASY" PAYMENT SYSTEMS OF HOUSE WIRING.

By V. ZINGLER, A.I.E.E.

(*Concluded from page* 533.)

Now there is no doubt that Mr. Rider has only put forward this ingenious scheme with the idea of enabling the Corporation to increase their electricity supply, and so to benefit the public not only by the general distribution at cheaper rates of a healthy illuminant, but also by saving their pockets from the heavy initial outlay otherwise involved by the adoption of the electric light. It is questionable, however, whether the scheme will commend itself in its financial aspects to students of scientific economy.

It is a curious medley of municipal socialism and reactionary individualism. Much as we all desire to see the general application of electricity either by private or by municipal enterprise, it is doubtful whether such a scheme as this should not be considered as dangerous — alike from the nature of the thing and the abuses it may bring forth. For what does it amount to? It is a scheme by which a municipality—a public body—takes upon itself the compound function of money lending and the support of one-man businesses. And what can it lead to? Nothing but bribery and corruption. What is to prevent councillors from having interests in the wiring firms thus supported, or from being themselves in receipt of "relief" on account of such work done for them, with the accompanying possibilities of fraud, commission, &c., which it is better not to enter into?

Consider the litigation which the Corporations will get into over clause (*a*)! Suppose that the satisfaction of the consumer does not correspond with that of the borough electrical engineer, and that the consumer refuses to pay anything further. Also, to whom will the installation belong during the period from completion to payment on the part of the Corporation? Who is to adjudicate upon extras, such a favourite item in a wiring contractor's bill? No doubt these are only minor points, and could be duly allowed for in any agreement; but the broad principle of the thing remains the same. We have not got so far in our social conditions that the community should be called upon to pay the debts of one of its items, or to suffer loss through the defaulting of a member.

It may be argued that there is no difference between this scheme and the Corporation wiring the man's house themselves, as in any case they spend the ratepayers' money. But there is a difference between paying a man's debts in money and in kind; if the consumer absconds or declares himself bankrupt, the money is as good as lost, as it does not follow that another consumer will always take the same house at once, or, having done so, will use the electric light; and he could not be compelled to do so, as the agreement would only be between the original tenant and the Corporation; whereas, if the Corporation wired the house themselves, they could come to terms with the landlord, so that their ultimate payment, with interest, would be assured.

These remarks are merely looking at the question from the standpoint of the community, and, apart from the fact that altruism does not flourish sufficiently among us that we should have a rabid desire to advance each other money *ad lib.* (for where electric light trades have this advantage others will also require it), it is questionable whether such powers could be exercised by a corporation without the permission of Parliament, or whether Parliament would give that permission.

Mr. Rider summarises the advantages of his scheme from the standpoints of Corporation, consumer and contractor, as follows:—

To the Corporation the advantages would be—

(*a*) The accession of a large number of consumers who would otherwise not be able to afford to adopt the electric light.

(*b*) The excellent control the Corporation would be able to exercise over the wiring of the premises, and the consequent raising of the standard of work.

To the consumer the advantages would be—

(*c*) The adoption of electricity as an illuminant without any heavy initial outlay.

(*d*) No extra price for current, as in the free wiring scheme.

(*e*) The cessation of all payments for wiring after a certain time, when the work would become the property of the consumer.

(*f*) The guarantee of first-class work, under the direct control of the Corporation.

To the contractor the advantages would be—

(*g*) A large increase of work in wiring premises.

(*h*) The certainty of payment on the satisfactory completion of the work.

Let us just consider these:—

(*a*) is no doubt the best advantage that the scheme has to offer. It may, however, be asked, are there many consumers who, if they could not afford to pay £100 down, would readily assent to a quarterly tax of over £12 for 21 months for the sole object of afterwards owning certain fixtures in a house which does not belong to them?

(*b*) If the control were to be greater than that adopted now, the Corporation would have to engage a larger staff. Besides, the controller would always be subject to being squared, or to getting on too friendly relations with contractors, as often happens now.

(*c*) The same remarks apply to this as to (*a*).

(*d*) This will be dealt with afterwards.

(*e*) Dealt with under (*a*).

(*f*) Dealt with under (*b*).

(*g*) Excellent for the wiring companies, subject to the scheme becoming popular with the public.

(*h*) Also good for the contractor, if no legal difficulties such as have been suggested before intervene.

We may now consider the scheme of the Free Wiring Company in conjunction with that of Mr. Rider's, in the relative positions of their advantages to the consumer, *i.e.*, to his pocket; for, after all, this is what the average man considers, and rightly enough, before all. And this comes in special relation to (*d*).

The consumers catered for under either of these schemes are those whose incomes are from £500 downwards, and who could not afford to pay £100 (or a proportional amount as their income decreases) in cash down for electric light. To these people—and they form the great majority of possible consumers—the question of the general application of the electric light and the consequent reduction in the charge per unit or in the parish rates, is as nothing compared with the sudden expenditure of one-fifth of their income. No doubt they would be glad to have the rates reduced, but not by the offer of such a sacrifice. What such a man has to consider then, under these alternative schemes, is this: Assume, for convenience, that he has 100 lights to be wired for at £1 each, consuming 18 units each per annum. Under Mr. Rider's scheme he will pay £100 + 5 per cent. = £105, in eight quarterly instalments of £13 2s. 6d. each, spread over 21 months. As Mr. Rider points out, this is equivalent to getting credit for the full amount of £105 for 10½ months, or at the rate of about 5¾ per cent. per annum. He will thus not only lose his interest on the £100 he spends, but he has to pay an additional 5 per cent. for the loan. His consumption per quarter will be, at 6d. per unit,

$$\frac{18 \times 100}{4} \times 6 = £11\ 5s.$$

Of course he may not burn anything like this, but the figures may be taken for purposes of comparison.

Now, if he takes up the scheme of the Free Wiring Company, he will have to add one-sixth to this latter sum, assuming that the charge is 1d. extra per unit consumed.

This will make his quarterly bill for current £13 2s. 6d., or, curiously enough, just equal to what he would be paying off quarterly under Mr. Rider's scheme for nearly two years, to obtain certain fixtures as his own property which are of no more value to him than the water-pipes in his house.

The sum he pays under the Free Wiring Company's scheme per quarter is £1 17s. 6d., or at the rate of 7½ per cent. per annum.

To sum up, under the one scheme he will be paying £24 7s. 6d. per quarter for two years, and £11 5s. per quarter afterwards, and own certain fixtures in, probably, another man's house, which would not realise anything; to

this would be added legal proceedings if he got into arrears. On the other hand, he would pay £13 2s. 6d. per quarter as long as he liked, with no disabilities attached except the cutting off of the light if he failed to pay.

It is for Corporations anxious to take up a scheme of this sort to consider human nature first, and to ask themselves which scheme they would prefer if they were in the position of this man.

As the writer is not aware whether Mr. Rider's scheme has been adopted at Plymouth or elsewhere, no figures as to its operation can be given; but there is no doubt that the scheme of the Free Wiring Company is being taken up by many supply companies and corporations. It must be evident that it is of great assistance to the supply companies and corporations for increasing their load; in fact, this is so to such an extent that some of them have decided to charge the consumer nothing for the hire of the wires and fittings—presumably instead of reducing the cost of the unit as the load increases. If the thousands of small houses in the suburbs which are without the electric light are considered, the possibilities of any scheme of this sort are immense; and that it is not only the small consumers who sometimes take advantage of it is shown by the fact that in one district worked on this scheme and started contemporaneously with the supply authority, considerably over one half of the consumers have been "free wired," and these used over 80 per cent. of the total current supplied.

Under this system the consumer has the option after five years of purchasing the installation on payment of the original cost plus 20 per cent., and less 1½ per cent. per annum from the date of installation for depreciation. It is not probable, however, that many consumers would avail themselves of this. Certainly, 20 per cent. seems a large profit, and 1½ per cent. a small depreciation after five years, and after paying 7½ per cent. interest.

But the system has this advantage—that the landlord does not in any way become responsible for the defaulting of any tenant, as the wires and fittings remain the property of the company, who can remove them if payment is not forthcoming. They are, however, bound to make good any damage caused by this removal.

In conclusion, it may be pointed out that when the gas companies saw their lighting business threatened by the introduction of the electric light, they applied themselves to encouraging gas cooking and heating by letting out stoves, &c., on hire for a very moderate sum. That there is a demand for these is shown by the fact that the gas companies' profits have not decreased, despite the great progress made by the electric light. As borough engineers and others are always grumbling at the great valley in their load curve, because most of their machines have to stand idle during the daytime, it is curious that no effort is made, either by the supply authorities, or some company, to let out on hire electrical cooking and heating apparatus, not to speak of motors. Owing to their cleanliness and economy in heat, there would no doubt be a ready demand for them, and the item of wiring would be extremely small.

THE MECHANISM OF ELECTRICAL CONDUCTION.*

We print in another column of the present issue (page 596) the latter part of an interesting and suggestive paper recently read by Mr. Reginald A. Fessenden before the American Institute of Electrical Engineers. The paper consists of two parts; the first, highly speculative, discusses the mode by which electricity is conveyed through solids, liquids, and gases, and supports the general view that all conduction is essentially convective, if the circumstances of the constitution of materials, solid or fluid, which determine whether they are conductors or insulators, are considered. We confess we do not follow throughout the reasoning of this part of the paper, but some account of its argument may induce our readers to refer, perhaps more intelligently than ourselves, to the original. The second part of the paper deals with the properties of insulating substances used in engineering practice, and appears to us of so much practical interest that we print it *in extenso*. That many of Mr. Fessenden's views admit of much controversy does not detract from their interest.

The author begins by drawing a careful distinction between the two qualities necessary to an insulator, viz., non-conductivity and dielectric strength; to both which qualities, he complains, the term resistance has been indiscriminately applied. He points out that water is, so far as the latter quality is concerned, at least as good an insulator as India-rubber, and, in another section of the paper, that only its enormous solvent power prevents its being a good non-conductor.

The paper then considers the mechanism of conduction in four sections: conduction by convection, conduction in solids, fluids, and gases.

Liquid insulators, even very perfect non-conductors, will conduct by convection, and this may cause serious leakage in high potential distribution. Convection is not recognised as occurring in solids, but is well marked in gases, vapours, and fluids. The mechanism of convection is the repulsion from a charged body of other bodies which have been in contact with it, which move away carrying with them part of its charge. Now, small bodies charged from another, comparatively large and smooth, are not repelled from but attracted to it; and though it is stated that the relation between the size of the particle, the voltage, and the radius of the charged conductor, when the particle after touching the conductor is neither attracted nor repelled, can be obtained by the method of images, no numerical results are given, for which omission the author apologises. Leakage between conductors in a liquid insulator, so far as it is due to convection, is caused by a motion of a portion of the oil as a whole, and not of its individual particles. Leakage by convection in a liquid insulator can be prevented in three ways:

"1. By using oil of great viscosity, in which case, however, we lose the chief advantage of oil insulation, *i.e.*, its ability to re-insulate quickly after a discharge."

"2. By putting pure dry cellulose in some form or other between the charged surfaces loosely, so that the oil can filter through it easily and any air escape readily, but sufficiently close to prevent any rapid flow. Pure cellulose has the great advantage that when well boiled in the oil it has approximately the same specific conductive capacity as the oil. No varnish or shellac should be used in the oil for reasons given later."

"3. By dissolving a solid, non-dissociating substance in the oil in such excess that it crystallises out at ordinary temperatures and forms with the oil a soft gelatinous mass, not fluid, but yet capable of allowing the oil to ooze through its substance. This has many of the disadvantages of 1, but it has one advantage, in that the substance chosen may be one, like paraffin, having a large specific heat of liquefaction, and consequently an overload will not raise the temperature of the oil above a fixed point till the paraffin is all melted."

No rapid movement of the liquid can occur in any of these arrangements, and the convection currents must be very small. It is further pointed out that the well known discharging effect of points is due not only to the great density of the charge at places of large curvature, but largely to the fact that very small particles are repelled from points, and can move rapidly away, carrying their charges, while they would not be repelled at all from rounded knobs or surfaces of small curvature.

In relation to the conductivity of solids, the author refers to a relation between the properties of a metal which he discovered and announced in 1892.

The conductivity of a pure metal is proportional to $\sqrt{\frac{\text{elasticity}}{\text{density}}} \div$ valency: or in other words, the product of the conductivity of a pure metal and its valency is proportional to the speed at which it conducts sound. In evidence of this law figures are given of 10 other metals referred to silver, but they closely satisfy the formula in only three cases, viz., gold, aluminium, and cadmium; the values in those cases being as follows:—

* "Insulation and Conduction." A paper read by Mr. Reginald A. Fessenden before the American Institute of Electrical Engineers, New York, March 23rd, 1898.

Metal.	Atom. Vol.	Atom. Wt.	Valency.	R. calculated.	R. observed.
Silver ...	10·2	108	1	100	100
Gold ...	10·2	197	1	135	137
Aluminium	10·5	27	3	152	159
Cadmium	13	112·2	4	456	450

In other cases there are discrepancies from 13 to 33 per cent. The worst case is that of iron, in which the calculated resistivity is 480, and the observed 646. Iron is taken to be octovalent, and if tetravalent the figure would be only 240, but Mr. Fessenden observes that "the magnetic metals, as iron and platinum, are very difficult to obtain pure. Their true resistance is, therefore, at present doubtful." The values attributed to the valencies of the metals seem somewhat arbitrary, and upon this point the author, referring to a diagram, in which, by the way, cadmium is assigned a valency 2, writes: "But there is no very definite rule. Among the univalent elements some unite with bivalent atoms, as does copper, and in general all that can be said is, that a certain valency holds generally and not in general. Consequently when we find that by taking a group of metals having very closely the same value of Young's modulus, as, for instance, gold, silver, and aluminium, their conductivities are, within the limits of errors of observation, proportional to the velocity of sound ÷ valency: and that in any of the group of metals having the same valency, the conductivity is directly proportional to the velocity of sound, within experimental errors, we are to a certain extent justified in making a choice of valencies when this is needed."

If this law be established it points clearly to convection as the mode of conduction in solids. To quote again:—"This formula throws a certain light on the nature of conductivity in solids, and why some solids are insulators. For the formula $\sqrt{\frac{\text{elasticity}}{\text{density}}}$ is the same as that for velocity of sound in a body. Now, in the convective discharge, the electricity was handed on with the same velocity as that with which the particles moved. In fluids, as we shall see, the electricity is handed on with the velocity with which the ions move. In both cases the electricity travels along on the particles of matter." A long quotation from Prof. Lodge follows indicating that this idea was well founded in his mind 10 years ago, and it is suggested that had he known of a formula subsequently discovered by Mr. Fessenden, and published in the *Electrical World* (New York), August 22nd, 1891, his views would have been much strengthened.

"The formula refered to is:

$$\text{Young's modulus} = \frac{78 \times 10^{12}}{(\text{atom. vol.})^2}$$

"Hence it is possible to predetermine the velocity of sound in wires by the formula:

$$\text{Velocity in cms. per sec.} = \frac{883 \times 10^4}{\text{atom. vol.} \times \sqrt{\text{density}}},$$

"and the electric resistivity is given roughly by:

$$\text{Resistivity} = 45 \times 10^{-9} \times \text{atom. vol.} \times \sqrt{\text{density}} \times \text{valency}.$$

"This formula possesses a general interest, inasmuch as it would seem that while the strain in the dielectric is propagated with the velocity of light, *i.e.*, $\sqrt{\kappa\mu}$, the actual electricity in the wire were handed on with the velocity of sound, and is proportional to $\sqrt{\frac{\kappa}{\mu}}$."

Mr. Fessenden thus arrives at the general conclusion that metals probably conduct by handing on charges to one another as they meet or collide in the course of their natural vibrations, and that the rate at which charges can be passed through their substance, *i.e.*, their conductivity, is proportional to the number of collisions in a given time, and inversely to the valency. The action of a high valency in reducing the conductivity of the metal is not very clear, but we understand that Mr. Fessenden looks on a high valency as involving small freedom of motion among the molecules, and so fewer collisions. An ingenious mechanical arrangement of balls carried on stretched strings is described, which would behave analogously to the author's conception of a conductor.

We find it difficult to follow the writer in his discussion of the molecular qualities necessary to produce solid dielectrics. He points out from a table of the elements constructed on Mendeléeff's principle that, as we proceed from the highly conducting metals used in commerce towards those of lower rows and higher valencies the substances get more crystalline, highly polymerised, and capable of existing in allotropic forms, and adds a number of general considerations on the effect of highly complex structure on the transmission of vibration. He concludes that for solid insulators we require "substances which are strongly linked together, of great density, and of small modulus of elasticity." In considering the conductivity of liquids the results arrived at by a number of well-known physicists are briefly stated, the condition that determines whether a given solution is an electrolyte or an insulator being the attraction of the molecules of the solvent for the ions of the solute. If this attraction is sufficiently great to overcome the cohesion of the molecule of the solute, and break it up into ions, the liquid is an electrolyte, but if not it remains an insulator. To quote Mr. Fessenden:—

"The conductivity of a solution is thus dependent upon the following:

"1. How powerful the attraction of the molecules of the solvent is for the ions of the solute, for on this depends how much of the solute is disassociated, *i.e.*, how many ions are set free to carry the current.

"2. How fast the ions move.

"3. What the valency of the ions is.

"In designing insulations the first is the important point, for from it we see that two good insulators mixed do not necessarily make a good insulator. A solid may dissolve in one substance and be an insulator in solution, but in another solvent may conduct quite well.

"This is what makes the chief difference between fluid insulators, for practically all the fluids which are not simple elements, like mercury, have very high ohmic resistance, and all have practically about the same dielectric strength. The ohmic resistance of pure water is, according to Kohlrausch and Heydweiller, about 1 megohm per cubic centimetre, consequently on account of its non-inflammability and great specific heat, its great heat of vaporisation and low boiling point, it would be a very valuable insulator for some types of apparatus were it not for the fact that it dissolves almost everything in slight proportions and splits them up into ions. Varnished paper will dissolve in some high resistance oils, forming a conducting solution."

In treating conductivity in gases, Mr. Fessenden adds little to what he has already said. Looking on all conduction as essentially convective, calling it electrolytic when the charges are conveyed by disassociated ions, he has no doubt that conduction by gas is usually electrolytic, but thinks it may take place by convection, using the word in the usual sense, in the arc and in the vacuum tube. "As regards the electrolytic discharge, this can only take place when the gas is disassociated by heat or by a strong slope of potential."

Our copy of this paper is an advance proof kindly sent to us from America.

A GREAT SCHEME OF ELECTRIC TRAMWAYS.

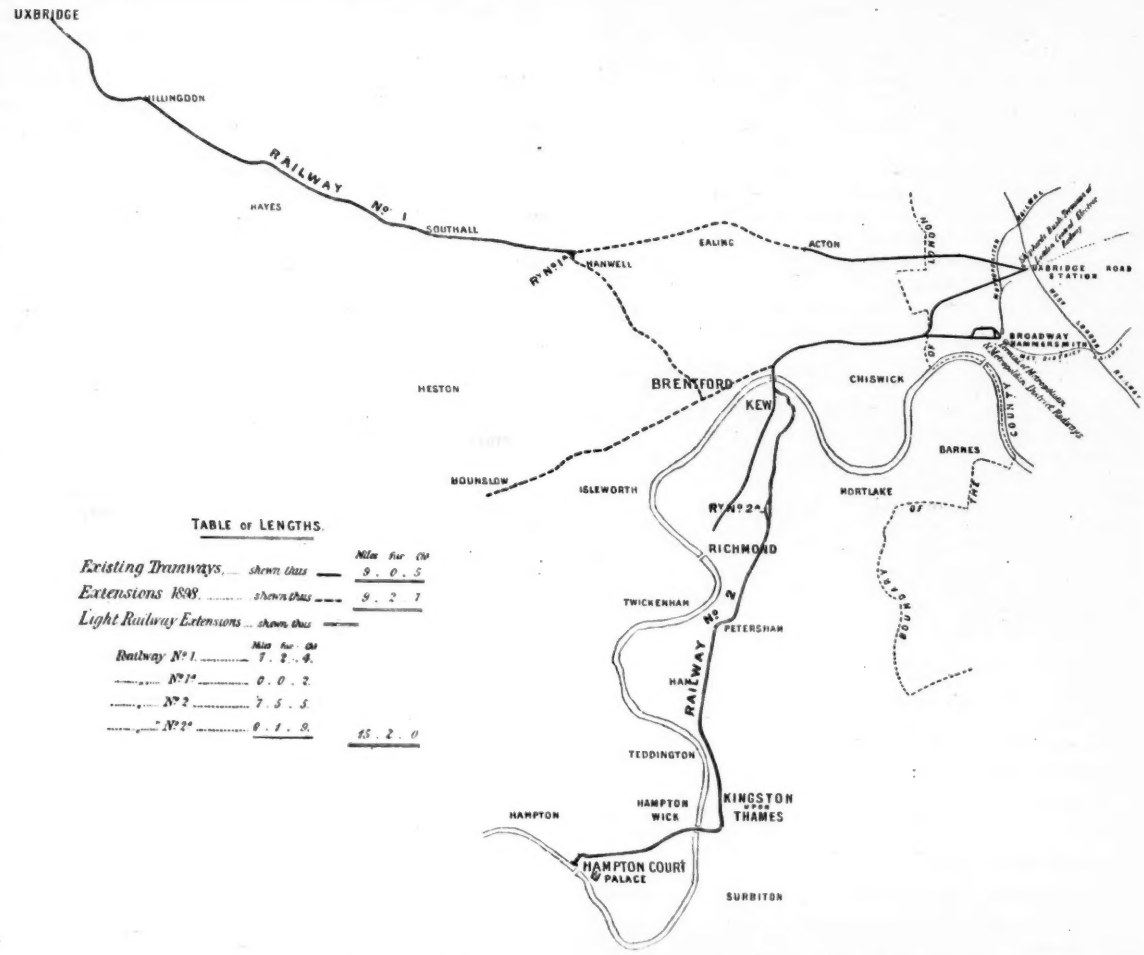
THE most ambitious scheme of electric tramways ever promulgated in this country is one that will provide a quick service of electric cars between Uxbridge Road Station and Uxbridge on the one hand, and Hammersmith Broadway and Hampton Court on the other hand. The proposed routes are clearly shown in the annexed map, from which it will be seen that the scheme embraces the equipment of existing horse lines with electrical plant and extensions into new districts. The present tramways are owned by the London United Tramways Company, of which Mr. Clifton Robinson is the engineer and managing director. It is perhaps hardly necessary to say that Mr. Robinson has been, and is, associated with most of the electric tramways that have been

laid down in this country, so he may be said to be well fitted to fight the cause of electric tramways in West London. For there has been a battle royal waged round electric tramways in the two parishes of Ealing and Chiswick; indeed, so high did local feeling run that the elections of the Chiswick and Ealing District Councils, which took place some two or three weeks ago, were fought on the question of permitting or preventing the admission of electric traction into the districts. The result of the elections was a signal victory for those candidates who sought the suffrages of the electors on the grounds that it was desirable to permit the tramways company to introduce electrical working on to that part of the system which passed through the district. The result of this appeal to the ratepayers is distinctively interesting, because it reveals in the clearest possible manner the attitude of the public on the subject of electric tramways, despite the insidious attacks and unfair arguments of its opponents.

The existing lines of the London United Tramways Company are nearly nine miles in length, and the system comprises lines from Hammersmith Broadway to Kew Bridge, Uxbridge Road Station to Acton, Goldhawk Road connecting Uxbridge Road with Hammersmith and Kew Green to Richmond. The Bill, which is now before Parliament seeks to extend the Acton line to Hanwell, and the Kew Bridge line to Hounslow, connection being made between Hanwell and Brentford.

Mr. Clifton Robinson is not, however, satisfied with this very considerable extension, because he is seeking on behalf of the company powers under the Light Railways Act to carry the system to Uxbridge on the one side and Hampton Court on the other, as shown in the map. Although the scheme is meeting with much favour from inhabitants, local authorities are inclined to resist the invasion of electric tramways, and no doubt a big fight will ensue. Some days ago we had the privilege of inspecting the present tramways systems and passing over considerable portions of the proposed route, and we must confess that we have visited no districts which appear to offer greater prospects for the successful working of electric tramways than the neighbourhood west of Hammersmith. The thoroughfares are wide and the population is exceedingly dense (in numbers). A well-equipped tramway system would prove a real blessing to the inhabitants and would, moreover, open up the country beyond Ealing and Hanwell which would be advantageous to property owners and residents alike. We have never seen a better equipped horse line than the system of the London United Tramways, the horses are excellent specimens and the track is kept in a highly perfect state; it needs only electricity to make it an ideal system.

It is not only, however, the inhabitants along the proposed route that will benefit from the efforts of the London United Tramways to introduce electrical working, for they are successful in inducing Parliament to grant them powers, they will have broken down the barriers that have hitherto prevented the introduction of electric tramways into London.



THE NATIONAL TELEPHONE COMPANY'S STAFF DINNER.

For the fifth time the members of the staff of the National Telephone Company have met and dined together. The event took place at the Trocadero Restaurant last Friday evening, and when we say that it was as successful as former gatherings we are according it great praise.

This annual meeting of the staff of the Telephone Company is an imposing, and at the same time, an interesting ceremony, because it may be regarded as the only occasion in the year that permits a representative gathering of the engineers and managers responsible for the telephone system of the country. It also furnishes an excellent opportunity for letting a little daylight into the arguments levelled against the existence of the Telephone Company.

A noticeable negative feature of the dinner was the absence

of Post Office officials, so we may take it that the ardent and disagreeable reformer, who last year made their presence at the annual dinner the subject of a Parliamentary heckle, has achieved his purpose. The directorate of the company was strongly represented, though the absence of the president, Mr. J. Staats Forbes, was regrettable. Lord Harris and Sir James Ferguson were there, while Prof. Hughes, Mr. Henry Edmunds and Mr. Gustav Byng were among the principal guests.

It was a dinner of few toasts, and was, perhaps, no worse for that. Mr. Gaine, the general manager, in proposing the National Telephone Company, spoke of its healthy condition. During the past year they had opened 90 new exchanges, and had increased their subscribers by 12,000, after allowing for those who ceased to be subscribers. They had been very active during the past year in laying lines underground. The great municipalities had recognised the commercial advantages of this means of communication, and had recognised that it was advisable in the public interest to make arrangements with the Telephone Company. The consequence had been that they were enabled to make great strides in all the large English towns in placing wires underground, and bringing the plant into efficient condition. He denied that the service was an inefficient one. Where facilities had been afforded the National Telephone service would compare favourably with that in any part of the world. Mr. Gaine, in speaking of the telegraph and telephone services, pointed out that by means of the latter, 430 millions of effective messages were sent last year, while the telegraph system sent 73 millions. Then the speaker passed on to consider the telephone systems of other countries, though he did not attach very much importance to the figures. Germany, with a population of 52 millions, had 107,000 subscribers; while England, with a population of between 38 and 39 millions, had 106,000 subscribers, that is, there was one subscriber in every 300; in Germany, 1 in 400; in France, where there were 30,000 subscribers, 1 in 1,200; in Austria, 1 in 1,500; in Belgium, 1 in 680; and in Holland, 1 in 1,000. He was not going to trench on political affairs, but it had been proved by experience that competition in their business was an impossibility, the system should be under one control and that an Imperial one; it always had been a monopoly and always would be.

Lord Harris in responding on behalf of the company compared face to face conversations with the telephone. If they saw a friend across the street engaged with someone else, or if they called at his office when he was engaged, they had to wait till he was disengaged. The same thing applied to the telephone service. If a subscriber used the telephone to a very great extent, the real remedy was to have more instruments All they asked for was fair justice; they sought a fair inquiry, and they did not fear the result if the judges would hear not merely those who condemned them, but those impartial critics who were judges of the difficulties of telephony.

The toast of the guests was responded to by Sir James Ferguson, and shortly afterwards the gathering dispersed.

THE EXTENSION OF THE PARSONS TURBINE PATENT.

The steam turbine is so very new an application of the direct action of steam, that we think every one will concur in the extension of the patent for a further term of five years. Now that the turbine has established itself as an economical steam engine and has, in the "Turbinia," given the world a taste of its qualities, we think the patentees will be able to look after themselves fairly well during the period of extension. Undoubtedly engineers have required a good deal of bringing round to the side of the turbine, and we believe they were at one time equally sceptical in regard to that other direct user of steam—the injector. Like the steam turbine the injector has a peculiarly economical side. Excepting so far as it has to lift its water supply we cannot see how the injector spends any heat excepting only what it loses by radiation, for all the steam it uses is returned to the boiler whence it came either as heat or in the form of motion of the water jet, which becomes converted into heat by friction with the water in the boiler. In the steam turbine a loss common to all heat engines of cylinder type is entirely avoided. We refer to the loss due to the phenomena of cylinder condensation and re-evaporation. These arise from the varying temperature of the working fluid, be this steam or the products of exploded gas, and the endeavour of the cylinder to approximate its temperature to that of the fluid in contact with it. The cylinder metal is in a continual state of change of temperature, and this is a condition which is universally conceded to be extremely inimical to the possibility of economical working. In the steam turbine, however, the working fluid flows in a steady stream through the various passages. True it falls steadily in pressure as it passes from disc to disc, and its temperature continuously falls also as it progresses towards the exhaust outlet. But at any one portion of the turbine passages the steam which passes that portion always presents itself at one steady temperature, and as this steam passes forward to other portions of the turbine passages, 1 inch, 2 inches, 7 inches or 2 feet distant, it will still encounter surfaces at each portion of its route which are at its own temperature. There is no interchange of heat between the turbine and the fluid passing through it unless it be the small amount required to make up any slight radiation losses. The steam will lose some heat by conversion into work, and to such extent will become moist, but the moisture will not be re-evaporated by the metal of the turbine; it will simply be carried along with the steam, and to some extent will retard the flow of this steam, and generally it will, we should say, act prejudicially, but only in a mechanical sense, and even this slight condensation will be prevented by a little initial superheat sufficient to provide the heat which disappears, or a portion of it. Indeed, the free expansion of the steam itself which probably occurs without performance of work will be effective to some degree in making good the heat which is changed into work. The enormous velocity of steam and the difficulty in applying such velocities to direct driven mechanism have been against the success of the direct use of steam. These difficulties have been very well overcome in the Parsons turbine, and such as they are, they are counterbalanced by the entire abolition of that *bête noir* of the reciprocating engine, loss by cylinder condensation—a loss which, though by some considered to be over-estimated and to be partially debited to leakages, is nevertheless a very serious item. The turbine, like the dynamo, can laugh at balancing troubles. If only made well and balanced, as pulleys are balanced, it ought to run without vibration at the highest speeds. With five years for further effort in front of them, we hope to see greater improvements still effected in the economy of the steam turbine by its makers.

THE PURIFICATION OF SEWAGE EFFLUENT BY ELECTROZONE.

We have been favoured with a pamphlet, "The Sterilisation of Sewage Effluents and Purification of Water Supplies by the Electrozone Process," containing reports made by Prof. Henry Robinson, Prof. A. A. Kanthack, and Dr. Samuel Rideal. The introduction of this pamphlet begins as follows:—"Under the patents owned by the British Electrozone Corporation, by the application of a current of electricity to sea water, or to an artificial salt solution, a steriliser, deodorant and purifier, called Electrozone, is obtained."

Electrozone is then no longer what a well-known Q.C. said in 1896 before the Board of Trade, something in which "there is neither electricity nor ozone."

We are not told what these patents are, nor what sort of electrolytic plant was erected near the outfall at Maidenhead in December, 1897. What strikes us *primâ facie* is that the conclusions of these reports are much more favourable to this electrolytic disinfectant than the previous reports made during the last few years by specialists and scientists on the same disinfectant.

We must be pardoned if we declare that we do not merely see in this the question of the deodorising and sterilising

power of an hypochlorite of sodium produced by electrolysis. The discussion of the bacteriological reports of Messrs. Robinson, Kanthack and Rideal on the germicidal properties of chlorine is not in our province; the main point which interests us is the production of the chlorine, and, to a certain extent, we should be justified in complaining of the reticence of the experts on the electrolytical question.

"As regards the efficiency of production of chlorine (expressed in grains of chlorine per Board of Trade unit), says Prof. H. Robinson, I have carefully analysed the figures contained in the daily reports from Maidenhead, and have made special trials with a view to ascertain the best conditions of working such as I could obtain from plant of a more permanent type than that now in use. Upwards of 3,000 grains of chlorine can be produced per Board of Trade unit in regular working with the existing plant, but I have obtained efficiencies, even with this plant, for short periods as high as 4,939, 4,813, 3,784, 3,538, 3,430, 3,420, 3,230, &c., and I am confident that much higher efficiencies than have hitherto been obtained in continuous working can be obtained in permanent works where the detailed arrangements of the plant and of the working are properly considered.

"In my estimates of the costs of the electrozone system, given hereafter, I have adopted only 3,500 as the efficiency to be relied upon in properly equipped plants for permanent work."

We do not in the least deny the disinfecting properties of electrozone; the whole affair is a question of £ s. d., but once more we must protest against the misleading name of Electrozone; it is simply ridiculous. "Electrozone" made by chemical means is Eau de Labarraque, hypochlorite of sodium or potassium; made by electricity, it is the Hermite electrolytic hypochlorite.

We must defer giving our opinion until we know something more about the electrolytic installation, the voltage, the amperage, the nature of the electrodes, the density of the electrolyte, &c. How much chlorine is produced with different densities of electrolytes? What is the yield of chlorine per kilowatt when the electrolyte used is sea water, and when the density of the liquid is 5, 10 or 15° B? This is rather important, as when tons of chloride of sodium solution are run into the sewage effluent, there is an enormous quantity of salt lost, owing to the considerable proportion of undecomposed salt.

We are decidedly partisans of the electrolytic production of chlorine for the purification of sewage. Whether it will be by the Webster, the Hargreaves, the "Electrozone," or any other process, is rather immaterial to us. In this respect we are like Iago, who does not care "whether he kills Cassio or Cassio him, or each do kill the other."

Provided we have plenty of chlorine at a low price, we are satisfied. Will it be the chlorine of the Electrozone that will solve this problem? This remains to be proved. And it is not out of place to ask what has been done by the American Electrozone Company during the last three years? Has it sterilised the effluents of Philadelphia, Boston, Chicago? We remember having read some very promising American reports on the purification of sewage by Electrozone. Is it possible that this work of sanitation has been discontinued, and if so, why?

We should like to see that the disinfecting liquid formed by the electric current is a great and indisputable success.

But although Messrs. Robinson, Kanthack, and Rideal may be very good electro-chemists, and know how to get the highest yield of chlorine from an electrolysed chloride of sodium solution, we are very desirous to be enabled to investigate the electrolytic method adopted by the British Electrozone Corporation and its superiority over other electrolytic processes.

We ought to have, for instance, one or two reports prepared by electro-chemists of high standing who would tell us how much chlorine is produced in a continuous process for a given expenditure of electrical energy in sea water or other cheap chloride solution. In plain words, we want to know the cost of chlorine per kilo.

There has been a good deal of controversy on the quantity of chlorine produced per ampere-hour, since the publication of the report, by some known experts, who stated that 1·45 grammes of chlorine was produced by 1 ampere-hour and 5 volts, equivalent to 80 kilos of chlorine per 272,300 watts. Prof. Robinson says that he can get 3,500 grains per kilowatt. This would make 226·64 grammes per kilowatt; and in round figures 272 kilowatts would give only 41 kilos 646 grammes, about half of what the Hermite experts, Raoul Pictet and others found.

We are the more inclined to insist on this, as Dr. Samuel Rideal himself, one of the scientists who report on this Electrozone process, does not seem to find that the electrolytic work is either admirable or perfect, since he says: "I estimate that the amount of available chlorine in the form of Electrozone could be obtained from a much smaller quantity of salt, whilst the power and labour would not materially differ."

We are asking in 1898 almost the same questions which Dr. Rideal asked in February, 1894, in a letter to *Industries and Iron*, in which he said:

"When we come to consider the behaviour of chlorine as a bactericide, the case is entirely different, as, without doubt, in order that it may be an effectual germ destroyer, sufficient of this element must be present over and above that required for the oxidation of the products of decomposition. It is very doubtful if the oxidising value of the Hermite liquor is sufficient to perform both these functions, and the adverse report on the sterilisation of the sewage at Havre points to the soundness of this conclusion."

"When information is forthcoming as to the actual quantity of salt electrolysed in the water, and the amount recommended for treating a given quantity of sewage, it will be easy to see whether the inventors of this process have made due allowance for the oxidation of the organic compounds which are associated with the bacteria whose destruction is aimed at."

His conclusion, then, was that it was desirable to obtain the following data:—

"1. The quantity of sea water electrolysed, and the efficiency of the electrolysis, *i.e.*, what percentage of the salt in the water is dissociated.

"2. The quantity of sewage treated, and the amount of chlorine required to oxidise it.

"3. The surface of metal exposed to the action of the electrolysed sea water, its rate of flow over it, and the loss of free chlorine in the passage of the water from the electrolyser to the sewage."

THE WAYS OF MUNICIPALITIES.

The electrical industry of this country is affected far more than it should be by the moods and fancies of Town and District Councillors, Vestrymen, and others. The scientific knowledge of these local dignitaries is seldom so accurate or extensive as it needs to be to make fair and reasonable criticism possible. The sum total of the knowledge of which they are possessed is, in nine cases out of ten, information read in some quasi-scientific publication specially intended for their edification, or in a daily or weekly newspaper. Of course there are exceptions, for in certain boroughs—few and far between—there are chairmen and members of electric lighting committees whose methods of dealing with electrical matters might be assimilated by the many councillors who have more delight in a heated squabble or a paltry quibble than a legitimate and reasonable discussion.

This is one of the evils attending the municipalisation of electrical undertakings, and as one occasionally sees how disastrous are the effects of the municipal magnate's ignorance upon the settlement of a question of this character—often delaying the carrying out of electrical works for several years, or tying the hands of those managing existing plants in an unreasonable manner, and hampering them in the fulfilment of their duties—then it is that one is convinced that the evil is of no mean proportions, but represents a state of things requiring to be grappled with.

To convince councillors that they don't know of what they talk is no easy matter, to instruct them were a better manner of dealing with them. If matters are to be satisfactorily settled, the municipal man must keep silence on points with which he is incapable of dealing. Otherwise there will be

repetitions of the blind leading the blind with the usual result.

To merely state half the truth may sometimes do more harm than a downright falsehood, and the question of half truths is making itself felt in certain parts of the country at the present moment where electrical schemes are being considered. Some councillors having made up their minds to oppose a scheme make a practice of bringing forward facts and figures showing that similar undertakings have been failures in other towns, but they fail to mention or to take into account in any way the more numerous instances of successful and profitable operation which would far outbalance the quoted failures—if they are genuine failures.

The municipal mind is not beyond reproach. There is even now such a thing as unfairness and corruption in English municipal life. But that it should have touched electrical work is a matter to be deeply deplored. That contractors or promoters should lend themselves to practices making municipal corruption possible comes to us as a surprise, and calls for a complete exposure.

Our contemporary *London* has been waging a righteous war in the camp of the Hackney Vestry, and has also been making certain investigations which do not redound to the credit of Fulham. In regard to Hackney, it will be remembered that for several years past there has been trouble re the electric lighting question, and the chairman of the Electric Lighting Committee seems now to have a burning desire that the Vestry should hand its provisional order to a private company upon certain conditions, and insert in the agreement a clause of early purchase if desirable. He considers that loss is certain, and we remember being present at a meeting of the Vestry a few months ago when this gentleman brought forward some figures of municipal plants which he said had resulted in a loss. His statements showed that he had inquired into the electric lighting question less than an electric lighting committee chairman should do, for he quoted as losses plants which are earning a profit. The Vestry consequently invited offers from companies willing to purchase the powers, and one of the offers sent in has been seen by *London*, and is quoted from at length. Curiously enough, the electrical engineer of the very successful municipal electrical works at Brighton—who, as most of our readers have heard, is now connected also with the British Thomson-Houston Company—champions the cause of the company, if *London's* statements be correct, by trying to dissuade the Hackney Vestry from doing exactly what he has been enabled to do with so great success at Brighton. It appears that Mr. Wright says that it would be an almost inevitable loss due to mistakes of policy and system during the first risky years of such a business. We quote: "The serious nature of this risk may be judged from the fact that all the following municipalities who put down their own plant made last year in their electricity departments very considerable losses, which in nearly all cases had to be made good by the ratepayers," this statement being followed by names of 26 towns. Our contemporary's reply to this is worth quoting here:—

> The list of places has been ingeniously selected. They either refer to works newly started or to places which have committed mistakes which a town now starting would avoid. Islington, for instance, had only a loss last year of £318, which is more than wiped out by the profit of the first quarter of this year. Mr. Wright ingeniously omits Hampstead, which in the second year of its enterprise had a surplus profit of £1,832. The loss in St. Pancras was incidental to the expansion of the undertaking. The profit in the previous year was £1,200, and on the whole of St. Pancras this enterprise has been profitable. The loss in Aberdeen was trifling, and in the previous year there was a profit of £435. Scotch towns do not seek to make a profit on such undertakings. The loss in Leicester was only £265, in Bolton it was £101, in Hanley £188, and in other towns the amounts were not "very considerable." But we decline to consider the deficits in the light of losses at all, as out of the gross profits the municipalities pay not only interest on the capital invested but set aside annual sums for depreciation of sinking fund. Judged by the same standard as companies would be, we find that the return per cent. on capital invested was as follows:—
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> | | | | | | |
> |---|---|---|---|---|---|
> | St. Pancras | ... | 5 25 | Dewsbury | ... | 7 21 |
> | Islington | ... | 3 60 | Dublin | ... | 4·95 |
> | Brighton | ... | 6·83 | Hanley | ... | 3·26 |
> | Bedford | ... | 3·74 | Leicester | ... | 4 66 |
> | Bolton | ... | 5·51 | &c. | &c. | |
> | Cardiff | ... | 3·64 | | | |
>
> Only in three places which Mr. Wright mentions was there an actual loss. Mr. Wright could have very easily selected a list which would have been convincing to the people of Hackney. He could, for instance, have cited Tunbridge Wells, which in the first year of its enterprise had a return of 11 per cent. on its capital and a surplus profit of £887, and other places where the first and second years have turned out profitable, and where the profits on the third year wiped out all the small deficits. Mr. Wright could have gone further, and shown how the municipal works in Brighton which he manages make a profit of £6,000 a year; how Bradford brings a return of nearly 12 per cent. on the capital invested; that Manchester made a profit of £17,000 last year, Edinburgh a profit of £3,400, and so on. Nor is it right to make comparisons with other places where the production of electricity is not mixed up with the disposal of dust, as is contemplated in Hackney. This entirely introduces a new condition of things, with possibilities of enormous economies, as Shoreditch is already demonstrating.

Our contemporary challenges Mr. Wright to deny that the return per cent. of gross profit on capital invested is not on the average higher in the case of municipal electricity works than for private undertakings.

There have been all sorts of charges flying about Hackney in respect of this electric lighting affair since the offers were invited. The committee are charged with being "treated" in a variety of ways, but by whom is a question not yet cleared up. It has even been said that a cheque for £400 was paid to one vestryman and smaller cheques to others. But by whom? That is the question. If by any of the parties anxious to secure the provisional order then there is room for an immediate inquiry to be instituted. For the present, without actual evidence, we cannot bring ourselves to the belief that such a state of corruption and bribery exists in connection with electrical affairs. We do not like to think it possible, bad as the appearances are.

To turn to another matter in connection with the municipal man and electrical works. There have been in progress for some months past, two schemes having for their object the distribution of electric power over large areas at cheap rates. The scheme of the Midland Electric Corporation for Power Distribution takes in the towns of Wolverhampton, Coseley, Wednesbury, West Bromwich, Dudley, Oldbury, and a number of other places in that neighbourhood; but this company has been hindered by several of the municipal authorities. The West Bromwich Council had a discussion regarding it, and in regard to the financial side of the question one of the councillors brought forward some figures as the result of the working of nine companies, from which it is shown that the revenue of these companies was £527,938, and the cost of working £262,390, leaving a profit of £265,508, and that after setting aside £78,999 for depreciation they had distributed in dividends £179,507. These facts, taken in this way, are misleading as applied to the case of a town like West Bromwich, especially as bearing on the proposal that the Town Council should generate a supply of electric current themselves. To make the profits appear too great is a weakness of many who are enthusiastic for municipalisation, in the same way as to magnify losses is a means adopted by those championing the cause of private enterprise. Mr. Allbright, one of the promoters of the scheme, writing to the local press on the subject, points out that an analysis, not of nine companies, working under most favourable conditions, but of the accounts of all the Corporation-managed supply works in the Kingdom should be made.

He suggests that it is not fair to pick out say nine of the best and largest electric lighting undertakings working in localities where the consumption is very great, and where the price which can be obtained for electricity is still very considerable, and then on these figures to assume that such a town as West Bromwich can produce results of approximately the same description, or that such figures can even be taken as a basis on which to form a reliable opinion.

Figures can be made to prove anything, either for the purpose of municipalities or companies, and the municipal mind is powerfully influenced by them. But whoever produces them should first be assured of their accuracy, and no cooking should be resorted to for the sake of proving a case where an industry of this kind is affected.

As showing the unreasonableness of the Wednesbury Corporation in respect of this Midland power scheme, we may mention that after the promoters had been for many months negotiating, the Council at the last moment decided by a majority of eight votes to five to apply for an electric lighting provisional order in opposition to the company. The Council is acting within its legal rights, but

whether the Wednesbury Council can do as well for itself as the company could by putting down its immense scheme—which would, of course, result in very low costs of generation and distribution—is questionable. However, municipalities have, in some parts of the country, treated companies in a merciless manner, for after securing powers they have often refrained from carrying them into effect, as the recent *Times* correspondence, reproduced in our issue of April 15th, goes to prove. We may, perhaps, just mention in connection with this power scheme a parallel case where gas interests were involved. There was formerly in the South Staffordshire district, a large gas company covering much the same area as the Midland Electric Corporation now proposes to do, and this gas company also supplied Birmingham. When Birmingham determined to go in for its own gas, some of the smaller authorities thought they would do likewise, and they set up their own plants in order to make a profit. Two of these authorities, at any rate, are now charging their ratepayers 4d. per 1,000 feet more, or about 12 per cent., above what they could have been charged by a large company. As these authorities, we believe, make some profit, it is seen that by their action they are not only keeping their ratepayers out of the advantage they might enjoy, but they are actually spoiling the use of gas in favour of the local rates, besides this the local authorities have incurred debts in each case of probably over £50,000. In the face of these facts, Wednesbury, a town of 24,000 inhabitants, has decided to oppose the Midland Electric Corporation and go in for its own installation, although the whole of the town is practically taken up with works, and there is very little outlook from an ordinary lighting point of view.

ACCUMULATOR ELECTRIC TRAMWAYS.

A DEPUTATION of the Blackpool Corporation, together with their electrical and tramway engineer, have issued an interesting report upon what they saw and heard on a tour through those Continental cities which have added electric tramways to their other means of locomotion.

Whether these trips in search of useful knowledge really have any influence in the decision of the questions regarding the systems to be adopted is very doubtful; at any rate, in one case, an important Yorkshire city corporation hurriedly settled the contracts for an American system of overhead trolley traction, and then sent out a deputation on a Continental tour, with their electrical engineer. Adopting a system first, and then making the grand tour, saves all bother in making reports and comparisons.

In the case of Blackpool, however, a really instructive report has been issued, with an earnest endeavour to arrive at facts regarding the results of actual practice on the Continent with the four systems of electric traction on tramways. They examined the overhead trolley, the conduit, the combined trolley and accumulator, and the accumulator systems.

Blackpool was a pioneer town in electric traction, and there the failings of the conduit system were laid bare. The deputation started out to ascertain the results of practice in accumulator traction, and it is from that point of view the report is interesting. Although it is not to be accepted as a correct comparison, nor its conclusions as authoritative, yet the information it gives is valuable so far as it goes.

They find that many disadvantages which were discovered in early accumulator systems have been entirely overcome, that the system is quite practicable, and has some advantages peculiar to itself; and the only reason why they cannot adopt it is one of expense. An accumulator system, to be worked successfully, costs much more in capital outlay and in maintenance than a trolley system, but not quite so much as the Blackpool deputation estimates.

The members do not take account of recent improvements in accumulators whereby an output of energy of 13 watt-hours per pound of battery has been reached; that is, nearly double the output of cells used for traction on the Continent. It may be said that these results require confirmation in practice before being considered, but still they show that the cost of battery traction (and that is its chief drawback) is being considerably lessened.

Then in calculating out the relative costs, no allowance is made for the fact that a battery charging plant costs less on capital outlay and in maintenance, and works at much higher efficiencies than a trolley traction power plant.

In the trolley system the power factor is very low, with the battery method it can be made over 90 per cent., while in the case of the trolley it is under 40 per cent.

The dynamos and engines in a trolley plant require to be large enough for the maximum current while running most of the time under half load, and the whole question has not by any means been decided by the report of the Blackpool Corporation deputation. The cost of current at a battery charging station properly laid out would be less than the cost of current from a trolley station, and still less than that from an electric light plant.

At present, of course, the accumulator electric tramways are in their development stage, while the trolley is in its fully matured state, so that corporations are not inclined to undertake much in the nature of experiments; but all the same accumulators go on improving, and we hope in the near future to find this system an active competitor with the successful trolley system.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ON Thursday evening last week the Institution of Electrical Engineers met to resume the discussion on Mr. Robert Hammond's paper: "The Cost of Generation and Distribution of Electrical Energy."

Mr. Preece being unable to be present, sent a written communication thanking the author for his excellent paper. Prof. Kennedy opened the resumed discussion by expressing his intention of, as time was short, not wasting any time in flattery. His succeeding remarks showed, however, that he fully appreciated the value of the paper. He endorsed Mr. Crompton's opinions, and thought that to those who are dealing with the question of costs everyday, figures tell a great deal, and are readily capable of interpretation. An immense number of points might be dealt with, and things said, but he preferred to confine himself to one or two matters of some importance.

He did not regard with favour the method of arriving at *ideal costs* * by taking the best figures from different stations, as we do not know how or why the various items are co-related. It is impossible to get the very best results for them all in any one works. Again, the table (No. XII.) showing load factor and units used in distribution, tells more distinctly than any other how complex the problem is; different systems astoundingly far apart, give more or less the same result. He hoped the uncomfortable person who thought he had discovered the *best* way of distributing electrical energy by a particular system, was dead and buried, as anyone who thought there was one, and only one, way of running a station, might learn something from a perusal of the figures in the table cited.

It would be foolish to deny that load factor is a very important matter, but he would not put it so high as Mr. Hammond does. Of course, if one could manage to get a nice comfortable rectangle it would be a boon, but the fact should be faced that apparently we shall always get a peak. Even if one could aim at a load diagram giving a rectangle, the rectangle in summer would enclose a much smaller area than in winter. Take the two Newcastle Companies, for example, with widely different load factors; it is a remarkable thing that the costs are practically the same, and the coal item is even higher for the company with the larger load factor. Many other features as striking as that might be cited.

Comparing the Charing Cross and Westminster Com-

* See page 305, No. 134, Vol. xxvii. of the *Journal of the Institution of Electrical Engineers*, or page 59 of the paper in proof.

panies, the costs are practically of the same order, and there is nothing to indicate that the difference in load factors affects the results at all proportional to what one would suppose. One might draw a curve from left to right horizontally or diagonally on Diagram III., showing units per 8-C.P. lamp per annum, and works' cost, and base almost any argument upon it, the conclusion being that the whole problem is so complicated in electricity supply that individual differences do not affect the result sufficiently to leave their mark. If the author had done nothing else, this deduction from his paper would have been valuable.

The engineer factor is a very big factor indeed, but can't be put on a curve. Prof. Kennedy does not suggest that the form on Table XVII. (p. 342 of the *Journal*) is any better than any other, but it is conveniently sub-divided to show the whereabouts of the remainder, after units sold to consumers, which should be known to the engineer in charge. When he had added up the losses and the quantity sold, a balance with the amount said to be generated should be obtained. He did know that in some cases the balance was struck within 1½ to 2 per cent. of the whole, and believed it was very much worth everyone's while to know it. Many items fall *pro rata* as the units increase, but stations are not working quite comfortably when up to ·4d. per unit has to be paid to the parish authorities.

Mr. Raworth first referred to the paper as a magnificent result of Mr. Hammond's labour on behalf of all those who had to do with electricity supply, and remarked briefly upon its bearing on the schemes for general supply of electric power over large areas. The personal element tells at once in a station. Thus, at Huddersfield, the item of oil, waste, &c., had been reduced to an infinitesimal 0·02d., and the most curious thing in the world is that this station is equipped with open type engines, which certainly do throw the oil about. Compare this remarkably low figure with stations at the end of the list, and it is found that several are using up to 0·40d., or 20 times the cost of oil, &c., at Huddersfield, while many stations spend actually less on coal than these latter do for oil, &c.

Coming to staff and management, it is apparent that London companies are much more liberal than municipalities. Some companies, such as the City of London, will never be able to show any record figures, as owing to the day load being variable, due to clouds passing over, a large staff, and many boilers under steam are the rule. The moment a man becomes financially interested in an electricity supply company he cannot be happy while the sun shines, and positively gloats over a fog. Prof. Kennedy, Mr. Raworth thought, was right, as works cost is not much improved by load factor. The effect is marked only when the increase of load factor is large enough. Thus the total cost of production in a certain works where a steady demand existed for 24 hours daily was 0·28d. per unit.

Mr. Shoolbred explained at length the use and effect on cost of batteries in low pressure stations, and thought they had a specially important bearing on financial results, in addition to simplifying regulation and acting as a reserve. He fancied that an electricity supply system ought not to differ from other supplies (gas and water), and cited the saying of gas engineers, that until storage is used electricity supply cannot be on a par with gas supply. Particulars of the load curves and cost of production at Birkenhead and Bradford were given, and it was shown that with small loads batteries are of great utility, but diminish in value as the load rises.

Mr. Patchell agreed that "salaries" ought logically to go into *generation* costs. He believed the statement of Mr. Arthur Wright that at Brighton the "charge is 1½d. per unit for all consumption beyond the average of one hour per day" was a most unhappy statement. So many people stopping short at the word "consumption." Mr. Patchell is by no means the only one who has found a wide-spread belief in this direction. He characterised *ideal costs* as "crazy patchwork." One station with 380 kw. installed and maximum load of 190 kw. is referred to in the table, and such should have practically no repairs. The Charing Cross Company found their theatre load lead to sudden calls upon the plant owing to rehearsals, and necessitated considerable stand-by machinery, thus affecting steam used and boiler losses. He wished he could get a huge, big, thumping battery, and rely on it. The speaker then drew attention to the care that must be taken if accurate results of *units generated* are desired, and thought stress should only be put on *units sold*. He noted that the sudden rise in "rents, rates, &c.," item synchronised with the new assessment in London.

Mr. Addenbrooke pointed out that the "load-factor" did not take into account how the units were generated before or after the time of maximum load: the rest of the load will vary with the breadth of maximum load in two load curves having the same maximum and factor. He elaborated this point by showing how the costs are affected by varying qualities, and mentioned that an article from his pen had appeared in the Electrical Review some 18 months or two years ago bearing on the matters under discussion.

It was noteworthy that at this point the statement was made, that although Mr. Wright had in a bold way called attention to the incidence of works' cost, the matter was perhaps being pushed a little too far, and people were penalised who wanted to use the current for a short time. We have had indications that a feeling is gradually growing that the present Brighton scale is not perhaps quite fair to the short-hour consumer when the supply is under the control of the municipality, although perfectly logical from the works engineer's point of view.

Mr. A. J. Lawson showed that the interest, &c., on capital on London stations as an average represented (taking 50s. per lamp for the capital expenditure) 3d. per unit, and that, therefore, a unit could not be sold for much less than 4d. He next indicated that the heavy salaries and management charges in London tend to prevent very low prices in the metropolis, and deplored the multiplication of generating stations by every little local authority. He found that the day load caused by the trams at Dover reduced the works' cost 1d. per unit. Regularity of supply is not peculiar to continuous or alternating supply, while the loss is only slightly different. In the case of two stations he had to do with :—

Richmond.	Wandsworth and St. Luke's.
Direct current loss was 10 per cent. only.	Magnetising loss on the alternating system did not exceed 15 per cent., owing to care taken in switching off idle transformers.
Economy in small stations of batteries very great, as one shift of men suffices.	

Mr. Sayer proceeded to explain how losses could be separated and classified in direct current and alternating current stations. The load factor he thought was controlled by the tariff. At Bournemouth—

1895.	1896.	1897.
8d. per unit.	7d. with rebate.	7d. with rebate.
7·1 per cent. load factor	11·2 per cent.	12 65 per cent.

Expensive coal might be cheaper than low price coal. The calorific value is not much guide, as the hydrogen calories are practically useless in a boiler furnace. Mr. Sayer's remarks are worthy of attention when the authorised report of the discussion reaches our readers.

Mr. Gadsby gave an equation representing the price he thought a corporation ought to charge for supply, say, to trams or similar load:

$$y = \cdot 002\, x + 100$$

where y = £ monthly paid for current

and x = units taken monthly.

Mr. Cowan believed that the mean radius of supply from mean centre of supply influences the cost of supply, and briefly discussed the incidence of distance to which units are distributed upon works' cost.

After Mr. J. W. Swan had contributed to the discussion, Mr. Hammond replied. His principal points were: the Board of Trade should amend its form so as to give us all the facts and actual figures; no difference should be made between companies and corporations; the form should embrace schedule of losses and statement of units, which should be made an integral part of the accounts. No works has reached finality in capital expenditure. Mr. Hammond rather set himself to press home the objects of his paper than to meet critical remarks, as time did not permit a full reply.

The meeting then adjourned the formal and proceeded to the informal discussion.

ELECTRICAL ENERGY (GENERATING STATIONS AND SUPPLY).

Viscount Cross presided on Thursday last week over the first sitting of the joint committee of the House of Lords and Commons appointed to inquire into the above subject. At the commencement of the proceedings a large number of applications were made by gentlemen representing companies, local bodies, &c., asking to be allowed to be heard before the Committee by counsel.

The Chairman said the Committee would consider that question later on in the day.

Sir Courtenay Boyle, in reply to the chairman, said he was the permanent secretary of the Board of Trade. The number of orders which had been granted since the year 1888 for electric lighting was 316, and at the present time there were 274 still in force. The total number of electric lighting licenses in the same period was 25.

How many of them exist at the present time?—Only three. Witness said that they took the period since 1888, because the Act of that year extended the tenure to 42 years, during which the local authorities could purchase the undertakings.

Although the particular Act refers to electric lighting only, there is no limitation in the Act?—No, but the procedure under Electric Lighting Acts has always been for the provision of energy for electric lighting purposes, but that energy could be used for lighting, telephoning, for propelling vehicles, or for cooking, or other purposes.

As regards powers of compulsory purchase of land?—The Board of Trade have no power under the Electric Lighting Act to authorise by order the acquisition of land for such purposes otherwise than by agreement. As a consequence of that, no lands are scheduled in the orders. The fact is, the undertakers get their land by private agreement.

I presume you have acted upon the general principle that electrical works, *primâ facie*, ought to be conducted without causing a nuisance?—The Board of Trade have always had that in view, but, of course, it is very difficult to avoid vibration, smells, &c.

As to compulsory powers of purchase, what are the sort of considerations that arise?—The first consideration is, is it desirable that there should be large generating stations, and that is a point upon which I have very little doubt the Committee will have a great deal of expert evidence. From one point of view there are great advantages in a few large generating stations supplying energy in large quantities under specially guarded circumstances and conditions, but if that is done the generating stations must, in the nature of things, be outside the area of supply of the various undertakers. Consequently there would arise the necessity for more frequently breaking up the streets. At present you have the generating stations of the undertakers in the area of supply, and they break up the streets. In London, as a general rule, there are two undertakers in every parish who supply electricity. If, in addition, you have a generating station outside the area of supply, you will get another party breaking up the streets. On the other hand, the difficulty of acquiring sites is unquestionable. Undertakers find it very difficult to acquire sites for generating stations. Generating stations must be an inconvenience, but they need not necessarily be a nuisance.

Undertakers are prohibited from supplying energy or erecting works beyond the area of their supply?—If they do so there is power to revoke the order.

But there is nothing to prevent their erecting generating stations outside their area, provided they can get leave?—The local authorities in some instances have given undertakers power to break up streets outside their own areas. The law officers have advised the Board of Trade that such a proceeding is *ultra vires*.

If you have generating stations outside the area of supply, there is a difficulty when the question of purchase by the local authorities comes to be considered. That is a very great difficulty, and undoubtedly there must be some inconvenience caused.

What is the period of purchase generally?—Forty-two years, as a rule. It is variable, however, by provisional order.

On the question as to what pressure should be allowed, the Witness said that no doubt the Committee would have witnesses before them who would say that it was just as easy to convey electrical energy at a very high pressure as at a low pressure, but perhaps they might hear from others that electric energy was like a wild beast in a cage, always trying to get out. For ordinary purposes, 3,000 volts might be considered high pressure, but the Board of Trade had given power in certain cases to a higher pressure than that.

About the telephone and telegraph systems; are you afraid they might be injuriously affected by high pressure mains?—Well, there is no doubt that high pressure currents, if there is anything like leakage, are a considerable danger to the telephone and telegraph systems, and there is considerable danger caused by leakage from high pressure mains. Sir Courtenay Boyle then referred to the Bill of the General Power Distributing Company, and of an application which had been made for a provisional order for the supply of electric energy in a large area in the Midlands from a generating station situated at Wolverhampton, and said there were many important questions which would have to be considered before those powers were granted.

None of the companies have a monopoly?—Oh no. They have no monopoly, and it is contended by the promoters of this Bill that if they get the powers they seek, they will be able to supply electrical energy for the use of mines, factories and lighting purposes at a very low price. The Witness, continuing, said he was unable at that moment to give the Committee accurate information as regarded the generating systems of America and Germany; but he would take care to give the Committee information on that point at a later stage. It would be very difficult to apply the principle of purchase by local authorities to such a case as the General Power Company; in fact he did not see how it could possibly be done.

By Lord Knutsford: He would not give local authorities power to compulsorily purchase works outside their own area.

Replying to Mr. Kimber, Witness said that if generating stations were a long distance from the area of supply, the voltage power allowed must be higher than if the station was in the area.

And in consequence of that, the interference with other electrical industries, such as telephones, telegraphs, electric tramways, &c. would tend to be very serious?—My own opinion is that it would tend to increase the risk of interference; but there are many electrical experts who do not think so.

Lord Balcarres: What was the reason which led the Board of Trade to allow two competing companies in every district in London?—Witness replied that that was really the result of a compromise, arrived at after a very long and elaborate inquiry in 1889, which was held with a view of determining whether competition in London should be allowed, or whether companies should be granted a monopoly. It was held as a compromise that it was desirable to grant two companies power over the same area.

And that gives a certain amount of competition?—Yes.

Is there any parish in which there are more than two companies?—Yes; there is a parish not far from here in which there are three, but there is no parish in which there are four.

Lord Mobley, Chairman of Committees of the House of Lords, was next examined as to the procedure relating to the granting of provisional orders. He said that, except as regarded tramways, the Electric Lighting Acts made no distinction between light and power. All companies applying for a provisional order must be limited companies incorporated under Act of Parliament. He said that Parliament was very jealous in respect to giving compulsory powers of purchase for any purpose, and the cases in which such powers had been given were generally under the Public Health Act, where it was clearly shown that the powers would be for the advantage of the public.

Would you be against granting compulsory powers simply to a limited company?—I don't like to go quite so far as that, but it is worth while the Committee considering whether the rule should be broken. It is an important rule, and I don't think it ought to be broken without the very clearest necessity being shown for it.

If compulsory powers are to be given, there are two ways to do it; either to come to Parliament, or to give the Board of Trade authority in the matter. Which process would you agree to?—I have rather a difficulty in answering that question. On the one hand I am extremely anxious not to break down the existing system, which has worked extremely well up to the present time by provisional order; and on the other hand I am reluctant that Parliament should give up its powers. It has been suggested that it might be possible, where companies require compulsory power, that they might come to Parliament first, and then go to the Board of Trade; but I think that would be too expensive and cumbrous.

Lord Knutsford: On the whole you are in favour of compulsory powers being granted only to companies that are incorporated?—Generally that is my opinion.

Of course companies cannot be incorporated under a provisional order, and therefore parties applying for a provisional order must be incorporated to meet your views?—Yes. Continuing, the Witness said that that delegation of compulsory power to the Board of Trade would throw a lot of extra work upon the department, and would introduce a new element of contention when provisional orders were asked for.

By the Chairman: It seems to me a very common sense point of view that it is desirable to get these large generating stations out of the large centres of population, the same way as gasworks are; but there are difficulties in the way.

By Mr. Kimber: He was not prepared to say that he would recommend the insertion of a "nuisance" clause if compulsory powers were granted, but he thought the Committee might very well consider how far these generating stations could be worked without creating a nuisance.

Lord Balcarres: With regard to the difficulty of purchase at the end of 42 years—is it at all likely that a local authority would wish to buy mains without plant, or plant without mains?—I should imagine not.

Need we take that into consideration when coming to a decision as to whether outside generating stations should be allowed or not?—Well, I believe thus far all the generating stations are within the area of supply.

Mr. Kimber: Excepting Deptford.

Lord Balcarres: But in the event of this General Power Distributing Company and this provisional order for the Midlands being passed, there would be two fresh cases in which a great central station will supply energy from points at from 12 to 26 miles distant?—That is so.

In considering this scheme, do you consider it necessary that we should contemplate that at the end of 25 or 30 years the local authorities would wish to buy bits of plant?—Of course it would be absurd for the local authorities to buy bits of plant.

By Lord Knutsford: It was quite possible they might wish to buy pipes in their own district, and have powers over them.

Mr. Chandos Leigh, Q.C., the speaker's counsel, was then briefly examined, and said that, generally speaking, he endorsed what the two previous witnesses had said.

The Committee then consulted in private for some time, and on the re-admission of the public the Chairman said the Committee had been considering the course of procedure in the matter. He wanted to call attention very specially to the exact order of reference, which was as follows:—To consider and report: (1) Whether, notwithstanding the provisions of Section 12 (1) of the Electric Lighting Act, 1882, powers should be given in any cases for acquiring land compulsorily for

generating stations; and if so, under what conditions as respects liability for nuisance, notices to surrounding owners, and otherwise. (2) Whether compulsory powers of acquiring land for generating stations, if proper to be given in any case, should be given where the proposed site is not within the area of supply. (3) Whether, in case of a generating station, however acquired, not being situate within the area of supply, power should be given for the breaking up of the streets between the generating station and the boundary of the area of supply. (4) Whether powers should be given in any case for the supply of electrical energy over an area including districts of numerous local authorities, involving plant of exceptional dimensions and high voltage; and, if such powers may properly be given, whether any, and what, conditions should be imposed—(*a*) With respect to system and plant, and to the construction and location of generating stations, in view of the powers of purchase conferred upon local authorities by Sections 2 and 3 of the Electric Lighting Act, 1888; (*b*) with respect to the relations of the promoters to other undertakers and to local authorities within parts of the area. (5) Under what conditions (if any) ought powers to be conferred upon promoters seeking to supply electrical energy to other undertakers and not directly to consumers. The Committee had determined not to travel out of that record by one single inch, and they would have nothing to do with particular Bills which were before Parliament at the present moment, as they were only there to discuss questions of general principle. They had also decided that all applicants who desired to be heard should send in their applications in writing, stating the particular points upon which they wished to be heard, and the names of the witnesses they wished to bring. As regarded counsel, the Committee would only hear one counsel upon one particular head, and the parties interested must agree among themselves as to the witnesses they wished to produce and as to the counsel.

After another adjournment, representations were made to the Committee by counsel and Parliamentary agents on behalf of the parties interested in the inquiry as to the matters desired to be raised from the points of view of various electric lighting companies and local authorities.

The Committee adjourned until Monday.

Lord Cross presided on Monday over the second sitting of the Joint Committee.

Mr. Frank King, engineer-in-chief to the Chelsea Electric Supply Company, was examined on the first head of the reference, and said that in 1895 his company acquired the reversion of a certain lease. A portion of the ground was covered by houses and shops, and in the area was a row of houses known as Steer's Buildings, and a stone-yard belonging to the Vestry. The total area of the site was 65,700 square feet. There were certain unexpired leases on the land. The London County Council authorised them to build on the site, and there was partly built a generating station thereon. The station had been constructed so as to be economical to themselves and innocuous to other people. One of the principal features to consider in making a generating station was the minimum plant required. They could put on 1 square foot of land generating plant which would light 7½ lamps at an ordinary equivalent of 8 candle-power. The houses on the site were of a very small class and in very bad order. They had a chimney 100 feet in height and one 150 feet high. The result was that the air was very much clearer than it used to be. The Alpha Place station was approved by the London County Council two years ago, and they commenced the erection of works immediately. They found great difficulty in getting the site cleared, and they had to pay extraordinary prices to get them out in anything like time, and the result was that they had been delayed very considerably while they were under statutory obligations to supply the demands of the district. In one case they had to pay £600 for a little fried-fish shop which was not worth £100. It took six months for them to safely erect a chimney shaft, and it took them at least 18 months to complete a generating station. The result was that if they were delayed six months they found they could not meet the demand. They desired to extend the station, and they had to acquire a cottage worth about £150, but the vendor wanted them to buy other property at a cost of £39,000. It was obvious that if they were to meet the growing demands of electric light, their plant must be commenced at the earliest possible moment. They had machinery ordered now, but no place to put it in. They could get on if they could get a portion of the Vestry yard, but the Vestry would not listen to any negotiations whatever. If they got the whole of the site, its capacity would be about 150,000 lamps. They believed that the area under their provisional order would absorb 750,000 lamps, and their present accommodation, adding the stations together, was for about 400,000 lamps. It was only possible for nuisance to arise from vibration or smoke and steam. For the purpose of obviating the first, they had twice substituted machinery, and they had now an engine which was absolutely free from vibration. They had eight engines at work at present, representing over 2,000 horse-power, and on examination in the adjoining house, they had failed to find any vibration. With respect to smoke, they burned the best smokeless Welsh coal that money could buy. They were watched very assiduously by the Vestry, and never received any complaint at all. They failed to find any condensed moisture in the neighbourhood. They did not intend to build any shafts less than 150 feet in height.

In answer to Mr. Coward, representing various Corporations, Witness said he had no objection to Corporations having similar compulsory powers to the companies.

Mr. Coward: You are seeking here compulsory powers. Do you see any objection to local authorities having notice of your seeking compulsory functions, and to them being heard if they think fit in the interest of the ratepayers?—I can understand that in the case of a new company; but in the case of an old company, I think it would hamper them.

By Lord Knutsford: The engine he referred to as being free from vibration was Willans. It was largely used by other companies. The man who wanted to sell them his property complained of the vibration.

By Mr. Kimber: There would be no objection to having the construction of the chimneys supervised so as to avoid smoke nuisance whatever the coal used was.

Mr. Kimber: Are you prepared to say as an expert that adjoining properties would not be affected by the vibration or smoke?—I am not prepared to say that.

The Chairman: Have you considered whether the action of your company would in any way interfere with the telegraph or telephone?—It would not.

Mr. J. I. Courtenay, chairman of the Chelsea Electric Supply Company, was next called, and, in reply to Mr. Coward, said he saw no reason why local authorities should not have the right to be heard before the companies got compulsory powers.

The Chairman said that was a matter of policy for the Committee to consider.

Mr. Sydney Morse, solicitor for the Chelsea Electric Supply Company, chairman of the Electrical Trade Section of the London Chamber of Commerce, and member of the Council of the Institute of Electrical Engineers, gave evidence regarding the standing orders of the Houses of Parliament before the change in 1893 and after. In a number of electrical railways Bills a clause was inserted with respect to generating stations. There would be great difficulty in incorporating electric light companies, because incorporated companies could only borrow to a certain extent, whereas the majority of the electric light undertakings had, under Stock Exchange rules, borrowed considerably in excess of the standing orders.

Answering Lord Balcarres, Witness said progress had been made to prevent nuisance arising from generating stations, but, of course, an engineer might not consider a thing a nuisance which a householder would.

Mr. Albert Gay, engineer to the Islington Vestry, said his Vestry had experienced some slight difficulty in regard to their generating station for the want of compulsory powers. They selected a site for the station which was bounded on two sides by a railway, but on one side there were several small houses they endeavoured to buy, but found a certain life interest in two of the houses which prevented them being sold.

This concluded the evidence on the first head of the reference, except that Sir Frederick Bramwell may be called. The Committee then proceeded to deal with the next two heads of the reference, dealing with generating stations outside the area of supply for the power of breaking up the streets.

Mr. Eustace Balfour said he was chairman of the St. James's and Pall Mall Electric Lighting Company, which started in 1888. He was also the chairman of the Central Electric Supply Company, which had a scheme before Parliament that session. It was proposed to acquire a site and supply electric current both to the St. James's and Pall Mall Company and the Westminster Company. The St. James's Company had had to pay very heavily for sites, and he did not know where it was possible to acquire a new site in the area. They had two stations, and there was no railway or canal convenience for bringing coal. Their coal consumption roughly came to about 200 tons a week. To get a generating station outside the area they would have to get compulsory powers to lay mains or else get the consent of the local authorities. It would, however, only mean the laying down once of a trunk main. The Central Company proposed to acquire a station in the parish of Marylebone which would furnish current to St. James's and Westminster. The demand for electric current was largely in excess of anticipation.

By Mr. Coward: The power sought to be acquired would enable the undertakers to break up the streets without the consent of the local authority, but considering the small amount of interference required, he did not think there should be any objection. He was not aware that in Manchester all the mains under the streets were acquired by the Corporation for the purpose of obtaining proper control over the streets. He was prepared to agree to a reasonable clause in conjunction with the local authorities. He would have no objection to paying a moderate rent for the use of the streets.

By Mr. Stevens: He did not know how far the principle of the General Company supplying other undertakers had gone, but if the St. James's Company had a breakdown, they would go at once to the London Company for a supply of current. The Central Company did not intend to supply the public.

Examined by Earl Spencer: The rapid growth of the use of electricity had forced them into having a central company to supply electricity to other companies.

By Mr. Kimber: In saying there would be one trunk line, he took it that they would keep others out; but still, if there was a rival the breaking up of the streets would not be what it is now.

Replying to Lord Knutsford, Witness said the Central Company had arranged to supply two companies, but they did not ask for a monopoly.

By Lord Cross: He agreed that England was behind other countries in electrical progress, and the compulsory purchase by the local authorities in 42 years had crushed many earlier attempts. He had not worked the figures out to see if it would pay to form a great central supply station to supply electricity for 50 miles round, but if it would he thought it would be a good thing.

Prof. Kennedy, F.R.S, engineer-in-chief to the Westminster Electric Lighting Company and joint engineer of the Central Supply Company, which had a Bill in Parliament to obtain compulsory powers, said that in two years' time the St. James's and Pall Mall Company and the Westminster Company would be at the end of their tether in supplying current. His company worked very smoothly with the local authorities.

Replying to Mr. Kimber, Witness said they hoped in the future to be able to supply current even cheaper. What they wanted

was power to be able to continue to fulfil their statutory obligations. The average price the Westminster Company charged to the consumer was 5½d. per unit. The cost of production was about 3d. per unit. He thought the only company that produced more cheaply was the Pall Mall Company. The Central Supply Company was promoted by the Westminster Company and the St. James's Company to obtain energy cheaper if possible.

By Sir Leonard Lyell: The mains they proposed laying down would not require to come up for 30 years.

By Mr. Ashton: The longer the distance away the generating station was the higher voltage would be required, but there had been no accident in London yet. The highest voltage in London was 10,000, and they only proposed to have 2,000.

Mr. Dobson, engineer to the St. James's and Pall Mall Electric Light Company, said they had had considerable difficulty in getting sites for stations in the area. They could put in enough plant in their present stations to carry them through two more winters; they would require 2¼ miles of mains to connect their station with the proposed station of the Central Supply Company, and those mains could be carried through by streets.

Mr. Morse recalled, produced a copy of the Bill of the Brompton and Piccadilly Railway Act, showing a generating station to be outside the district served. The station of the Strand Company was in Lambeth, and originally at Bournemouth, the site was outside the area of supply. It was a common thing for companies to cover several areas. He thought it would be impossible to turn electric lighting companies into incorporated bodies, for all electric lighting companies were limited liability companies.

CORRESPONDENCE.

Re-winding Field Coils of Dynamo.

I have a two-pole dynamo coupled to Willans GG engine, wound to give 115 volts and 275 amperes. With my load this is attained at a speed of 350. I wish to re-wind the field coils to get 135 volts and 275 amperes at 400 revolutions. Present coils are wound with No. 8 B.W.G. wire, covered to 5 B.W.G. They heat badly at 115 volts. There are 82 coils of wire outside, measuring around outside 6 feet 7½ inches, and the depth of the windings is $2\frac{13}{16}$ inches. The inside of the coil frame is 1 foot $10\frac{1}{2}$ inches by $10\frac{1}{8}$ inches. What diameter of wire, covered and uncovered, should I use for the new winding, and what will be the approximate length on each pole?

Subscriber.

[There is, evidently, not enough wire on the field-magnet, and probably no room for more. To get 135 volts the speed would require to be raised to 415, and No. 10 B.W.G. wire used on shunt laying on as much as space will allow. More specific instructions had better be obtained from the makers of the dynamo.—Eds. Elec. Rev.]

Jerry Wiring.

As a wireman of about 17 years' experience, during which time I have been engaged on bell, telephone, and telegraph wiring, arc and incandescent lighting (both alternating and continuous), transmission of power, accumulator and tramway work, and also in connection with electro-chemistry, I think I may speak with some authority on this matter, and I can assure Mr. Jeckell that the jerry wiring fiend still flourishes in other places besides South Shields, in spite of regulations and testing sets. I have known personally of tests made which never reached beyond the first group of branch cut-outs, these being placed close to the ceiling and the fuses left out, and the testing inspector contenting himself with the assurance of the man in charge that all fuses were in. Turning in another direction, I once worked for a firm in this town for nearly four years, and carried out many fairly large installations for them. A slack time came and every man in the shop, except myself, was discharged for want of work. I was promised by the senior partner, in the presence of the only other partner, that if I would stand by them they would find me as much work as they possibly could during the slack time, and send me out in charge of the first decent job they got. This was about Christmas. About April I discovered accidently that they had on at a popular watering place, a job of 300 incandescents and eight arcs, and that they had about 10 men on it, all working overtime, while I and my family were scraping along as best we could on about three days per week. On reminding the firm of their promise to me, I was very coolly informed that I had not been, and could not be sent to the job, as I was too expensive, as these fellows were working for 6½d. per hour, while I wanted 8d., and asked for no expenses, whereas I had always had from the firm 14s. per week without any demur. You will see, therefore, that on a 50 hours' week, as we worked, these fellows each cost £1 0s. 3d. per week less than I did. But were they wiremen? To my own personal knowledge four of them had never done an inch of wiring in their lives, having been for a short time previously labouring for wiremen, one of them having been an outside telephone labourer. Now what can you expect under these circumstances but jerry wiring of the worst possible kind? When the better class of contractors combine with consulting engineers and insurance companies to induce the Board of Trade to oust the jerry wiremen and the jerry contractor from the business by establishing a scheme of compulsory registration for wiremen and persons in charge of jobs or electrical departments, each having to pass a practical examination before being registered and receiving his certificate, then we may kill jerry wiring, but all the exposures in the world will not do it, as they will still revert to their old tricks in dark places, such as false roofs, &c.

Wireman.

Back E.M.F.

Will you please advise me whether the method I adopt for determination of the back electromotive force (B.E.M.F.) of an electrolytic bath is correct.

At a slow speed I get at the brushes 84 volts (E) and 143 amperes (C). At an increased speed I get 116 volts ($E + e$) and 249 amperes ($C + c$).

Difference in reading 32 volts (e) and 106 amperes (c).

$$\text{The B.E.M.F.} = (E - e) - \left(e \frac{C - c}{c}\right) = 40{\cdot}9 \text{ volts.}$$

If this is correct, is the actual electromotive force generated in the dynamo at full speed $116 + 40{\cdot}9 = 156{\cdot}9$ and the electrical horse-power $\frac{156{\cdot}9 + 249}{746}$?

E. D.

Steam Relief Valves.

Several serious accidents have recently taken place owing to water in engine cylinders. The small steam space in many water-tube boilers has, in some instances, contributed to this.

In the description of electric works in your columns, I have not found reference to precautions against such accidents. It appears to be admitted that ordinary relief valves cannot get rid of any serious rush of water. What are the best means to adopt? Is a large steam separator sufficient to hold, on an emergency, the water due to bad priming, or due to a burst or failure of another engine? If so, what are the proportions?

Colonial.

[Our descriptions may not perhaps make special reference to the means for overcoming the effects of priming, because these appliances are by no means general. At the same time, we have referred to such means in other articles—one recently in which we discussed the recent breakdown at Yarmouth. It is hardly possible to say how big a separator should be, but we incline to the use of a separator of the pot or U type between the boiler and engines, and we are also of opinion that engine steam pipes should branch from the top of a steam main, not from its side or bottom. We certainly would not trust to cylinder relief valves for relief of priming due to overfilling of boiler. With the steam pipes arranged as above, the steam main ought to be well drained at its lower end, and such abominations as ring mains ought not to be allowed with their multiplicity of valves and connections, which introduce far more complication and risk of accident than is likely to occur with a well-designed steam main.—Eds. Elec. Rev.]

Shoreditch Destructor.

I have been very much interested in reading the report of a deputation from Tunbridge Wells to Shoreditch. Please read enclosed copy; can you give any explanation of the very extraordinary fact that the great fun of the whole affair, "thermal storage," finds no place in the said report, also that the financial statement is now "expected" to be issued in June next—if I remember right it was to have been at the end of March—and further, that no particulars of cost, &c., for comparison could be obtained, &c.

Power.

[From the cutting enclosed the report appears to be that of a deputation from Maidstone.—Eds. Elec. Rev.]

BUSINESS NOTICES, &c

Electrical Wares Exported.

Week Ending April 26th, 1897	£	s.
Adelaide	21	0
Alexandria	200	0
„ telephone ...	64	0
Amsterdam	332	0
Antwerp	394	0
Auckland	28	0
Bombay	20	0
Buenos Ayres	413	0
„ Teleg. mat.	110	0
„ Teleg. wire	338	0
Calcutta	273	0
Cape Town	311	0
Christiana. Teleg. mat.	73	0
Colombo	53	0
Copenhagen	75	0
Durban	1,138	0
„ Teleg. mat. ...	2,971	0
East London	352	0
Flushing	213	0
Ghent	14	0
Gibraltar	18	0
Grenada. Teleg. mat. ...	15	0
Hamburg. Teleg. mat.	610	0
Kurrachee	166	0
Madeira	882	0
Melbourne. Teleg. mat.	280	0
Port Elizabeth	1,205	0
„ Nolloth	14	0
Rangoon. Teleg. mat. ...	75	0
Reval. Teleg. mat. ...	15	0
Rio Janeiro. Teleg. mat.	510	0
Rockhampton	17	0
Rotterdam	250	0
St. Petersburg	1,040	0
Shanghai. Teleg. mat.	24	0
Singapore	110	0
Stockholm	156	0
„ Teleg. mat. ...	214	0
Sydney	1,132	0
Wellington	351	0
„ Teleg. mat. ...	66	0
Yokohama	240	0
Total ...	£14,791	0

Week Ending April 26th, 1898.	£	s.
Adelaide	122	0
Alexandria	25	0
„ Teleg. mat.	205	0
Amsterdam	110	0
Bangkok	13	0
Barcelona. Teleg. mat.	41	0
Beira. Teleg. mat. ...	47	0
„ Teleph. mat. ...	372	0
Bombay. Teleg. mat. ...	416	0
Bordeaux. „ „ ...	74	0
Boulogne	67	0
Brisbane. Teleg. mat.	1,251	0
Buenos Ayres	280	0
Calcutta	344	0
Cape Town	292	0
Christiana	40	0
Colombo	83	0
Copenhagen	75	0
Delagoa Bay	490	0
Demerara	8	0
„ Teleg. mat. ...	104	0
Durban	934	0
„ Teleg. mat. ...	1,780	0
East London	215	0
Flushing	49	0
Fremantle	105	0
Hamburg	135	0
Lisbon	15	0
Malaga	353	0
Melbourne	332	0
North Sea. Teleg. cable	5,996	0
Oamara	858	0
Piræus	110	0
Port Elizabeth	107	0
Porto Alegre. Teleg. mat.	30	0
Rio Janeiro. „ „	4,704	0
Saigon	30	0
Santander	50	0
Shanghai	37	0
Stockholm. Teleg. mat.	165	0
Sydney	966	0
Townsville	400	0
Trieste. Teleg. mat. ...	400	0
Vera Cruz	57	0
Wellington	291	0
„ Teleg. mat.	337	0
Total ...	£22,919	0

Foreign Goods Transhipped.

	£	s.
Calcutta	55	0
New York	177	0

An Improved Electric Furnace, Welding, or Brazing Machine.—The investigations and experiments by M. Moissan, Prof. Roberts-Austen and others, as to the behaviour of metals, alloys, ores, and other materials when subjected to the intense heat of the electric arc, together with the practical use of electric furnaces for the reduction of ores, notably those of aluminium and others of a refractory nature, have resulted in the desire of other investigators to enter the same field and rendered the subject of some importance in technical education. The want of efficient apparatus at a low cost for the purpose of experiment and illustration has hitherto resulted in the operator manufacturing his own out of materials at his command. To meet the demands for such apparatus, the following—originally designed some years ago by Mr. W. Clark Fisher for private use—has been placed upon the market by Mr. R. W. Paul, of Hatton Garden. In the design it was sought to provide an instrument alike suitable for furnace, crucible, open hearth, welding, brazing, and hard soldering, &c., for which purpose it was desirable that the carbons should be capable of universal movement admitting of their being placed at any angle in any plane. In order to achieve this, as shown by the illustration, the framework supporting the carbon holders consists of a slotted arch of metal cast in two halves mounted upon a fire-resisting and insulating base and efficiently insulated from each other at the top where they are bolted together. The carbon holders have a swivel action fitted with thumbscrews so that they may be clamped in any position, the swivel action is attached to an insulated bolt which passes through the slots in the framework and allows of adjustment to any height. Each carbon holder having an action

entirely independent and thoroughly insulated from each other and the framework, it is easily seen that they may be arranged as in the illustration for crucible, welding, or brazing work at a suitable angle, or both placed horizontally, or one horizontal and the other vertical, &c., for furnace work, and to suit requirements. The apparatus at present is made in two sizes, one for 10 to 15 amperes at 50 to 100 volts, the other 60 to 80 amperes at 50 to 100 volts.

Chain Gear Catalogue.—We are in receipt of an advanced copy of the chain gear catalogue of Mr. Hans Renold, of Manchester, who has made chain gears a specialty, and by his peculiar system of chain has overcome the objections which formerly obtained on account of wear, which varied the pitch of the chain. In Mr. Renold's chain the variation of pitch due to wear of the pins corrects itself by the assumption by the chain of a larger radius of revolution, and the design of the links is such that they enter and leave a wheel without rubbing friction. Mr. Renold claims to be able to run these chains up to a velocity of 1,600 feet per minute, at which speeds the chain is no more noisy than a leather belt. Like many other mechanical appliances, the chain has fallen into perhaps undeserved disuse on account of its bad construction. Mr. Renold aims to make a chain perfect, and expects thereby to make it satisfactory, and from all we hear is doing well, and producing good and reliable chains equal to claim.

Change of Address.—Messrs. Allingham & Fennell, electrical engineers, have removed from 27, Bower Road, Victoria Park, to Harrow Green, Leytonstone, N.E.

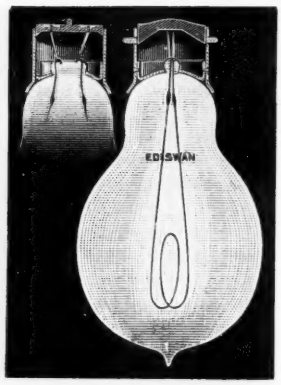
Church Lighting.—Messrs. Calvert & Company, of Manchester, have recently carried out a number of church lighting installations, near Manchester. The latest, the Emmanuel Church, Southport, was completed for the opening service on April 10th. The installation consists of some 250 16-C.P. lamps, in fittings of 18, 12, and 10 lights inside the church, and 100-C.P. lamps on ornamental posts outside, the lights being arranged so that either one-third or two-thirds may be switched on at once from the main board in the lobby. This firm have also carried out the electric lighting of St. Luke's Church, Southport.

Electric Light Cables and Wires.—Mr. Isidor Frankenburg, of the Greengate Rubber and Cable Works, Salford, Manchester, has sent us a list and samples of electric light cables and wires manufactured by him. The conductors of all the cables and wires which are given in the list consist of the best copper wire having a guaranteed conductivity of 100 per cent. of pure copper (Matthiessen's standard). In the various tables there are given dimensions, weights, resistances, and capacity of the conductors, and prices appear of taped wires and small strands, taped and braided ditto, taped and braided vulcanised electric light cables, wires and cables for aerial work, also cables and wires insulated with pure rubber. We have examined the various samples sent, and they all appear to be well made mechanically.

Electro-Zincing.—We understand that electro-zincing has been adopted by Mr. Peter Brotherhood for his air compressor tubes, and a plant is now being erected at his works on the Cowper-Coles regenerative system.

The Hook of Holland.—After many complaints, says the *Times* Rotterdam correspondent, about the insufficiency of the lights at the entrance by the Hook of Holland, the Minister of Marine has decided to ask for a credit in next Budget for two electric lights of the highest power to take the place of the present two red oil lights.

Dry Cap Lamp.—The dry cap lamp shown in the illustration is specially recommended by the Edison & Swan United Company for use in damp places or outside lighting. The lamps are specially suited for mines, pier lighting, or damp cellars, where it has been found that the plaster of Paris softens after the lamps have been in use for a little time. The cap is attached by means of a brass disc and is fastened to the glass bulb by specially prepared cement, which is thoroughly damp-proof, and the leading-in wires



are perfectly free, so that the lamp has an air insulation in the interior of the cap. It is important to note that although there is an air insulation, by using the thin layer of cement between the brass and the glass, it acts as a non-conductor and consequently there is very much less heat conducted than there would be if the brass and glass were not intercepted.

Meeting of Creditors.—At the offices of the Manchester Official Receiver, on 19th inst., a meeting was held of the creditors of James Fletcher and John Arthur Hirst, trading as Fletcher, Hirst & Co., electrical and mechanical engineers, at the Bankfield Works, Curzon Street, Burnley. The statement of the debtors' affairs showed liabilities expected to rank for dividend £2,184, and assets £424. It was stated that debts to the amount of £1,131 had been proved. The debtors made an offer of 6s. in the pound, to be paid—3s. within seven days of the creditors' acceptance of the offer, and 3s. after the lapse of six months. The creditors present were willing to close with the offer, but it was pointed out by the chairman that it was neither within their power nor that of the Court to do so. The lowest composition that could be accepted and approved was 7s. 6d. The meeting was therefore adjourned for a month, to give the debtors an opportunity of making a further offer to the amount required by the statute.

Price Lists.—Messrs. Laing, Wharton & Down, Limited, have issued some advance lists of new alternating and continuous current apparatus which they are introducing. The lists particularise "Whardown" transformers, G type, illuminated dial measuring instruments, transformers for voltmeters and wattmeters, economy coils, single-phase motors, also "Whardown" continuous current motors and dynamos and combined fans and motors. We understand that the firm attaches great value to the entirely new style of switchboard instruments which are illustrated, and although they are only listed for alternating current work, they may shortly introduce a line of continuous current ones. Special attention is directed to the 500-volt motors and motor fans in view of the demand likely to arise for motor current at this voltage in connection with the supply of current for electric traction.

Messrs. Wilhelm & Co., London agents for Mr. K. Wienert, of Berlin, sends us a list of the "Sonja" long hour arc lamp with enclosed arc burning from 100 to 200 hours for continuous and alternating current.

The Vestry of St. Mary, Battersea, v. The County of London and Brush Provincial Electric Lighting Company, Limited.—On Thursday, April 21st, Sir Francis H. Jeune, sitting as an additional judge of the Chancery Division of the High Court of Justice, resumed the hearing of the above-named action, which was brought in order to have the question decided whether the defendant company, who hold a provisional order enabling them to supply the electric light within the district of Wandsworth, were entitled thereunder to lay their pipes in Trinity Road, Battersea, part of which was, admittedly, in the parish of St. Mary, Battersea, and within the area of supply of the Battersea Electric Lighting Order. For the defence it was contended that this was not a case for a mandatory injunction, even if the defendants were in fault. Mr. R. Bray, Q.C., and Mr. Chapman appeared on behalf of the Vestry, and Mr. Cripps, Q.C., for the defendant company. The case was opened before His Lordship on March 9th, and a note on the subject appeared in the Electrical Review at the time.

On Thursday last week, when the case came up again, His Lordship pronounced judgment, and said he should have been very glad if the case could have been settled between parties, but that had been found impossible. Public bodies as well as individuals were entitled to have their rights adjudicated upon, even although they afterwards might see fit to arrive at an arrangement. Dealing with this case purely as a matter of law, the only question he (the judge) had to consider was that of the remedy to which the plaintiffs were entitled. That the defendants were wrong in what they had done, was, to His Lordship's mind, beyond doubt. The Act of Parliament approving the order under which the defendants worked, clearly defined their rights and powers, and it was equally clear to his mind that the plaintiff Vestry had vested in them—whatever the words might mean—the area in which the defendant's wires had been laid. It was also clear that the defendants had no right, without the consent of the plaintiffs, to lay their wires in that area. The defendant company was clearly wrong in what it did, and he felt bound to say that their conduct was as wrong as the principle under which they had acted, because it appeared that sometime before the particular act complained of the company had acted in a precisely similar manner, and laid down wires in another part of the same road, and when their attention was drawn to it they took up the wires and apologised. Afterwards they applied for leave to place their wires in the same area, but that being refused, they took the law into their own hands, in the manner which had been put before the Court. Under the circumstances the question was what was the remedy to which plaintiffs were entitled, and as to that he thought the case was governed by that of Goodson *v.* Richardson, which was a decided authority in plaintiffs' favour. The conclusion to which he (Sir F. H. Jeune) had come, was that the defendant company should be called upon to remove the wires in question, and that there ought to be judgment for the plaintiffs for a mandatory injunction, and a declaration as prayed for with costs. His Lordship, however, on the application of Mr. Cripps, suspended the operation of the injunction for three months, with liberty to apply in the meantime for leave to appeal.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Gas and Electric Lighting Committee had under consideration last week the suggestions by Prof. Kennedy, with reference to the extension of the electric lighting to the west end of the city. It was decided to carry out the proposal by which the extension could be effected at a cost of £5,700. The Committee also resolved to extend the Union Street electric main at a cost of £168. The offer of Mr. Henry Brechin to supply steam coal for the electric station at 8s. 6d. per ton has been accepted.

Ashton.—A circular *re* electric lighting, drawn up by Mr. Clirehugh on behalf of the Council, is being distributed in the borough.

Bangor.—The City Council has resolved upon gas extensions, and at the same time has decided to establish electric lighting works for supplying current for Garth Road and High Street at a cost of about £10,000. Ratepayers have given a guarantee of £500 a year for the electric lighting.

Barking.—On 21st inst. a Local Government Board inquiry was held into the Urban Council's application for a £15,000 electric lighting loan. The Barking Gas Company and a body of ratepayers appeared in opposition. Mr. W. C. C. Hawtayne, the consulting engineer, explained the scheme in detail. He estimated the working expenses as 2½d. per unit, and the annual gross revenue at £2,600. After paying for working expenses and allowing for renewals and repayment of capital and interest, and assuming that in addition to the public lamps the Council supplied private consumers with an equivalent of 3,000 8-candle-power lights, there would be a profit of £309 available for the reduction of rates or other purposes.

Bradford.—The Bolton Road and Morley Street tram routes are to be lighted by means of arc lamps at a cost of £500 a year. The charge for lighting current is to be reduced from 5d. to 4½d. per unit, with a sliding scale for the motive power.

Belfast.—The engineer recently presented a report on the comparative cost of electric and gas lighting for streets, with particular reference to some of the main thoroughfares, which, briefly summarised, conveyed the information that the present method of lighting the principal streets is, if considered sufficient, the cheaper, taking into account the fact that it is done at a loss; but if electric current were employed for the purpose, 3·75 times the light could be given for 2·2 times the cost, without loss to the department, while the ordinary street lamp could be replaced by incandescent electric light at the price at present paid. The report, in an amplified form, will again come before the committee.

Chislehurst.—The Board of Trade have approved of the Chislehurst Electric Lighting Order.

Croydon.—Mr. G. W. Willcocks held an inquiry at Croydon, on behalf of the Local Government Board on Tuesday, respecting the application of the Town Council to borrow money for the purpose of additional plant in connection with the electricity works, for additions to the electric lighting station buildings, and for £1,000, the sum payable by the Corporation to the British Thomson-Houston Company, Limited, upon the Corporation determining the period of working at the end of the first year, as referred to in Clause 18 of the agreement dated March 12th, 1896, and made between the British Thomson-Houston Company, Limited, and the Corporation. The total amount required by the Corporation is £6,772; but the inspector said an item of £2,772, required for the additional plant at the electric lighting station, did not really come within the scope of that inquiry. Alderman Miller said they asked for sanction for these items in consequence of the increased demand for supply. They already had double the number of customers, and

were still increasing at the rate of about 150 lamps per week, and they were compelled to hold over applications until additional plant was put. Unless they got this by September, they would be unable to supply the demand during the winter.

Dartford.—The District Council has appointed a Special Committee to deal with the electric lighting question.

Edinburgh.—After referring the matter back to the Lighting Committee, the Council has now adopted the recommendation to light certain streets by means of arc lamps. The salary of the resident electrical engineer has been raised from £500 to £600.

Fermoy.—The Town Commissioners have resolved that the agreement with Mr. Haynes Reed with reference to the electric lighting scheme for the township shall be signed without further delay, so that the lighting may be introduced before next autumn.

Fulham.—A special meeting of the Vestry, held on Wednesday last week, decided to carry out the provisional order and proceed with the erection of an electric lighting station, a dust destructor and disinfector. The cost of the scheme is estimated at £56,000.

Glasgow.—The Corporation has agreed to supply current to the Clyde Trustees for the lighting of the Queen's Dock and Prince's Dock at 2d. per unit, the trustees to provide all the necessary lamps and carbons for same, and to undertake the trimming of the lamps. Negotiations are to be opened with the Glasgow Harbour Tunnel Company, Limited, for obtaining a wayleave for laying and maintaining one or more electric cables therein.

Greenock.—The application of the North British Electricity Supply Company to the Board of Trade for a provisional order to supply electric lighting to Greenock, Port Glasgow, and Gourock has been meanwhile declined by the Board. Representatives from the three towns and of the company interviewed the Board of Trade on Friday last, and Sir Courtenay Boyle said that in the event of the Greenock Corporation not taking advantage of their provisional order for the supply of electric light to the town and district within a year, the application of the company would be favourably considered.

Hackney.—Deputations appeared before the Vestry on Wednesday, both in favour and against the disposal of the electric lighting order to a company. No conclusion was come to, however, for the matter was referred to the joint committee. It appeared from the proceedings that Mr. Medhurst has served a writ on the Vestry. A special committee has been appointed to deal with the matter.

Hampstead.—The Lighting Committee received a report from the chief electrical engineer explaining the advantage of adopting the use of demand indicators on the premises of all consumers of electric current, and recommended that demand indicators be fixed on all consumers' premises, present and future, in order that the charge for current supplied may be uniform throughout. Mr. Cottam stated that the indicators would cost about £2 each. The total outlay would be nearly £1,600. The recommendation was defeated by 18 votes against 15.

High Wycombe.—The Electric Lighting Committee, after having an interview with Mr. Bastian (on behalf of Messrs. Hodges & Todd, the electrical engineers appointed by the Corporation), and also with Mr. Wigham (engineer on behalf of Edmondson's Electricity Corporation, who are constructing the works for the Wycombe Borough Electric Light and Power Company), have made various recommendations to the Council regarding the general details of the undertaking, and these have been adopted. The positions for the arc lamps for street lighting are to be settled later.

Huddersfield.—The Electric Lighting Committee reports that the number of consumers this month is 650, an increase of 18 compared with March. The lamps connected during April are 44,047, an increase of 752, compared with the previous month.

Kimberley.—According to the last advices, a private Bill is to be introduced during the next Session of Parliament to empower the Borough Council of Kimberley to supply electricity for the purpose of lighting, heating, or furnishing power to public buildings and other places, and to borrow a sum of £25,000 for this purpose.

Leyton.—On 20th inst. a Local Government Board inquiry was held into the District Council's application for sanction to borrow £15,000 for electric lighting purposes. Mr. Bishop, the electrical engineer, explained matters. There are at present 6,780 lamps (public and private), 29 being arcs, and 500 or 600 lamps waiting for connection.

Longton.—The Corporation of Longton, who have resolved to take up the question of municipal electricity supply, have retained Mr. Robert Hammond as their consulting electrical engineer to lay a scheme before them.

Loughborough.—The General Purposes Committee has resolved, upon the Gas and Electric Lighting Sub-committee's recommendation, to apply for an electric light provisional order, and to spend £50 for professional assistance for the purpose of the proposed application. The matter will come before the Council.

Lowestoft.—The General Purposes Committee of the Town Council considered last week the alterations made by the Board of Trade in the electric light provisional order.

Lyndhurst.—Before committing themselves to the electric light, the Parish Council want to know terms. A letter from an electric lighting company has been before the Council.

Maidstone.—The Maidstone Town Council have resolved by eleven votes to six to defer the matter of the electric light until the result of the first year's operation of the Shoreditch electric light and dust destructor scheme has been ascertained.

Manchester.—We briefly mentioned in a "Note" last week the estimated surplus of the Corporation electricity undertaking for the ensuing year. We now give the exact figures as stated by Alderman Higginbottom at last week's meeting of the Electricity Committee. The estimated expenditure on revenue account is £53,829. The leading items are: coals, £7,700; oil, waste, water, &c., and current used on works, £4,300; repairs and maintenance, renewals of plant (transfer), £9,000; interest on mortgage debt, &c., £9,700; and sinking fund, £10,328. The estimated income, by sale of current and meter rentals (including £1,500 receivable from the city fund for public lighting) is £66,000, leaving a profit balance of £12,171, out of which it is anticipated that £12,000 will be devoted to the relief of the rates. Last year the estimated income was £55,000, and the actual income £57,800, which yielded a surplus of £14,080. The estimate of expenditure on capital account for the year ending March 31st, 1899, is as follows: land (sub-stations), £6,900; buildings (sub-stations), £5,000; buildings and foundations (Dickinson Street), £5,000; machinery, £59,000; mains, £60,000; meters, £3,000; cable stores and workshops, £5,000; total, £143,900. The estimate of expenditure on street lighting for the same period is: current for public lighting, £1,500; lamps and connections, £5,500; making the amount required to be raised in the current year's rate £7,000.

At an adjourned meeting of the City Council on 20th inst., with the consent of the Council, Mr. Alderman Higginbottom was permitted to introduce, out of the ordinary course, the recommendation of the Electricity Committee to make application to the Local Government Board for their sanction to the borrowing of the further sum of £150,000 for the purposes of the electricity undertaking of the Corporation. In moving the adoption of a resolution approving the Committee's recommendation, Mr. Higginbottom said the money was required for electricity purposes in the city, Moss Side, Levenshulme, and Withington, under orders which had been sanctioned by Parliament. In Manchester it was needed to provide (1) six new feeders to supply the old network. These would be necessary to convey the current from the new generators to the distributing mains. (2) Distributing mains in Chester Road and City Road. These mains it had already been determined by the Committee to lay forthwith. In addition to these, it would be desirable to connect up with Moss Side along Denmark Road and Moss Lane, and also along Preston Street. Borrowing powers would also be required for the erection of cable stores and a testing room on the land at the Polygon, and for purchasing sites for transformer sub-stations in various parts of the city. The high pressure feeders would be necessary for supplying some of these sub-stations, and also the sub-stations in Moss Side and Levenshulme. Provision was also made for carrying out the street lighting which it had been decided to provide for winter. There had likewise been included a sum for new services and meters in the city area. In regard to Moss Side, the money was required for the distributing mains in the compulsory streets and for the high pressure mains. At Levenshulme the money was required for a site for a transformer sub-station, for distributing mains in the compulsory streets, and for high pressure feeders. At Withington the money was required for sites for transformer sub-stations, for distributing mains in the compulsory streets, and for high pressure feeders. The following was a summary of the estimated cost:—Manchester, £73,300; Moss Side, £15,600; Levenshulme, £8,970; Withington, £48,920; total, £146,790. This would leave a sum of £3,210 for "sundries and contingencies." Sir John Harwood suggested that the sum asked for should be £200,000, and moved an amendment accordingly. This was seconded by Mr. W. Pollitt, and the Council agreed to it.

Metropolitan Asylums Board.—At the meeting on Saturday the Works Committee submitted a report in regard to the proposed electric lighting of the Northern Hospital. The Committee stated that Messrs. Burstall & Monkhouse, the consulting engineers, had informed them that in view of the great rush in the engineering trade, and in order that the engines and dynamos, as well as the boilers required for the electric lighting, might be delivered before next winter, it would be desirable to issue the specification for these works in advance of the specification of the wiring and other electrical work. The consulting engineers suggested further that, from the nature of the work, it was desirable to obtain tenders from a limited number of approved firms, rather than by advertisement. The Works Committee therefore recommended, and it was decided to apply to the Local Government Board for assent to obtain tenders for the engines, dynamos, and boilers for the electric lighting of the Northern Hospital in the manner suggested by the engineers.

Messrs. Handcock & Dykes, of Westminster, S.W., have been appointed consulting electrical engineers in connection with the electric lighting of the Tooting Bec Asylum.

The Brook Hospital Committee reported having consulted Prof. Kennedy, who designed the installation at that hospital, in regard to the maintenance of the storage battery. The Committee suggested that an agreement should be entered into for the maintenance of the battery for three years, but by the consent of the Board the recommendation was withdrawn for the time being.

Newmarket.—The Council does not approve of the site suggested by the electric light company.

Norwich.—A local paper says that the construction of the tramway track is now being proceeded with.

Peterborough.—Official intimation has been received by the Town Clerk that the Local Government Board has, upon further consideration, agreed to sanction the Peterborough Corporation borrowing a loan of £15,000 for electric lighting.

Plymouth.—The foundation stone of the Corporation electricity works was laid by the Mayor (Alderman J. T. Bond) on 21st inst. Mr. A. R. Debnam, chairman of the Electric Lighting Committee, explained the extent to which it was at first intended to provide current for lighting and traction purposes.

Portsmouth.—Last Saturday a visit was paid to Portsmouth by Mr. Gilbert, the president of the Boston Electric Light Company (U.S.A), and Mr. Hosman, the engineer and secretary to the company. They are stated to be making a tour of Europe to discover the best system of electric street lighting, in order that it may be introduced into Boston, which already boasts the largest plant in the world, the street arc lamps there numbering no less than 2,800. Mr. Gilbert is reported to have declared that though he had been all over the Continent, he had never seen so good a system of arc lighting as there is at Portsmouth.

Ripley.—A petition is being signed in Ripley in favour of electric lighting.

Shanklin.—The Shanklin Trade Union had a discussion on electricity *v.* gas a few days ago.

Sheffield.—A public meeting of the owners and ratepayers of the city was held on Tuesday to consider the Council's proposal to promote a Bill for the purchase of the electric light undertaking and raising money for the purpose. The proposal was not approved by a majority of those present, and a poll is to be taken in May, the result to be declared on May 25th. A Sheffield paper implies that the meeting was attended by a number of electrical traders who were afraid that the Corporation might take away their wiring and fitting business, and they seem to have been responsible for the voting.

Southampton.—At the last meeting of the Harbour Board, the Works Committee reported that the electrical engineer (Mr. J. G. W. Aldridge) had submitted plans of the necessary electric mains for the new cranes at the Quay, estimated to cost about £350. He stated that the cable could be purchased of the makers and laid by the Board's staff. The Board accepted the Committee's recommendation to adopt the plan of the electrical engineer.

St. Pancras.—The profit on the last year's working of the electricity undertaking has sufficed not only to wipe out a deficit of £800 on the previous year's accounts, but to provide a balance in hand of £5,717.

Swansea.—At a special meeting of the Corporation on Friday a report of the sub-committee was received showing that they had failed to arrange with the British Electric Traction Company to supply the latter with electricity for the trams at 1½d. per unit up to 400,000 units, and 1¼d. per unit for any subsequent amount per annum. The company explained that it was undesirable that the tramway power should be secondary to the lighting, and continuity of supply was imperative. The company also could not pay any more than the actual cost of production, and therefore would provide their own works. The sub-committee advised the immediate proceeding with the Corporation's own scheme, in combination with a dust destructor, as it was most necessary to have the station in their own hands. Mr. Manville, the electrical engineer engaged, attended, and after a long discussion it was decided, with only two dissentients, to proceed with the scheme, and to borrow £60,000 for the purpose.

Taunton.—The Council last week adopted a recommendation of the Electric Lighting Committee that the sum of £11,500, instead of £10,000, as previously agreed upon, should be applied for in order to provide for renewal of plant. Messrs. Kincaid, Waller & Manville, electrical engineers, of Westminster, presented a long report, which was explained by Mr. Manville, who attended the meeting. He said the electric light installation in Taunton was one of the first in the Kingdom for public lighting purposes, and they necessarily had to start with plant which was usual in those days, and in fact the only plant that could be obtained, and in the extensions made by the Bill since they took the works over from the old company they had proceeded on the lines originally laid down. Those lines did not involve the greatest amount of efficiency in the running of the station, and his firm were anxious that the whole system should be brought up from the present somewhat antique design to the most modern lines, so that the station might be as efficient as any existing. If his recommendations were carried out a gross saving of £539 a year would be effected on the basis of the present output, and there would be a net saving of £373 a year after providing for payment of capital and interest on the money required for the proposed alterations. The report was adopted.

Tipton.—The District Council on Tuesday heard representatives of the Midland Electric Corporation, and, after discussion, resolved to withdraw the opposition to the scheme.

West Ham.—Last Friday a Local Government Board inquiry was held with respect to an application by the Town Council for sanction to borrow £2,841 for the purpose of lighting the public buildings in the borough by electricity.

Wolverhampton.—Public notice is being given, signed by Mr. Harman Lewis, the borough electrical engineer, to the effect that on or about 28th inst. (yesterday), the supply of electric energy is to be commenced at a standard pressure of 220 volts, from Albany Road, on the north side of Darlington Street, on both sides of Chapel Ash, Tettenhall Road to the Clevelands, Compton Road to Chapel Terrace, and Merridale Road to Oaks Crescent.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bristol.—The chairman and vice-chairman of the Bristol Sanitary Committee (Alderman Cope Proctor and Mr. G. Pearson) having talked over questions of electric traction still in dispute with the representatives of the Bristol Tramways Company, reported to their committee the result of their negotiations and made certain recommendations as to the course to be taken. A draft report to the Council was drawn up and this was dealt with and revised at another meeting of the Committee held on Monday It will be presented to a meeting of the City Council on Friday. It shows that there have been concessions on both sides, but there are still terms remaining unsettled. One point upon which the company has agreed is that of the capital required for works not less than £200,000 is to be raised in such a way that the rate of interest thereon shall not exceed 4 per cent. They are also willing that the fares shall be reduced so as to average ½d. per mile for ordinary passengers, and ¼d. per mile for workpeople's cars, the times for running which are to be extended. The controversy over the period at the end of which the Corporation shall be permitted to purchase resulted in 17 years from May, 1898, being agreed upon. The draft report set forth that the company should not be required to pay a wayleave for the permission to use electric traction, but this the Committee at their second meeting altered, and the report advises the Council that no arrangement would be satisfactory which does not require the company to pay a moderate wayleave, that there should be a further reduction of fares, and that the Corporation shall have the right to veto the overhead system in certain limited areas of the city.

Bournemouth.—The British Electric Traction Company and the Bournemouth, Poole and District Light Railway Company having informed the Council that they propose amended schemes, the Council has resolved that it is still undesirable that tramways should be laid down in the borough, and that steps are to be taken to prevent powers being granted.

Buenos Ayres.—The chairman of the City of Buenos Ayres Tramways Company, Limited, addressing the shareholders last week in London said that the question of the adoption of electric traction instead of horse-power had been fully considered by the board and by the local committee and general manager. They had received a report from the local committee regarding the possible advantages and disadvantages of the adoption of electric traction. That report was handed to an eminent firm of experts, who arrived at the same conclusion as the local committee—namely, that the substitution of electricity for horse-power was not desirable either in the interest of the public or of the company. After serious consideration of the whole question, the board had come to the decision that although the electric motor system might possibly be adopted with advantage to suburban traffic, it was absolutely unsuitable to the narrow streets in which their lines were laid.

City and South London Railway.—Lord Morley's Committee of the House of Lords has passed the City and South London Railway Bill, which confers extension powers. The company is also to raise £133,000 additional share and loan capital. The powers originally sought for the purpose of selling a portion of the undertaking to the City and Brixton Company have been struck out of the Bill.

Dundee-Barnhill.—A private meeting of the Broughty Ferry Police Commission was held last week at which representatives of a Leeds firm submitted plans of a proposed electric railway between Dundee and Barnhill. The system proposed is of the overhead trolley type, and the proposed route will be from High Street, Dundee, thence along Seagate, Blackscroft, and Ferry Road, crossing the railway at the Oil Mills, and onwards to Broughty Ferry, along Queen Street, Monifieth Road, to Barnhill. The Broughty Commission is stated to have agreed to support the scheme. Official notice of the scheme, published in a Dundee paper, is signed by the solicitors and Parliamentary agents, and also by Messrs. Greenwood and Batley, Limited, Albion Works, Leeds, promoters; Mr. Robert Ord Ritchie, M.I.E.E, Albion Works, Leeds, electrical engineer; and Messrs George Hopkins & Sons, 30, Parliament Street, Westminster, S.W., civil engineers.

Ealing.—The old District Council pledged itself to strenuously oppose the scheme of the London United Tramways Company, but now that there is a new council in office, eight of its members being in favour of electric traction, there seems to be some prospect of the matter receiving careful reconsideration. Notice of motion has been given for the question to be discussed at the next Council meeting.

Hastings.—On 20th inst. the Town Council held a special meeting to discuss the tramways question, and a resolution was passed by 24 votes to 14 applying to the Light Railways Commissioners for an order authorising the Council to construct and work light railways in various parts of the borough.

Hungary.—According to recently published statistics, the total length of street railways in Hungary at the end of 1897 was 115 miles, of which 64 miles were worked by electricity. In the past year the introduction of electric traction on the street railways of Buda-Pesth was completed, and, besides two new railways worked by electricity were opened, namely, the "Miskolczer electric street railway," and the "Maria Theresiopoler electric railway." The traffic on some of the Buda-Pesth electric railways show a considerable falling off in 1897 when compared with 1896; a result which is ascribed to the Millenial Exhibition in the latter year.

Malaga.—It is proposed to convert the horse tramways in the town of Malaga, Spain, into electric lines.

Moscow.—The April *Board of Trade Journal* has some interesting notes regarding the proposed electric tramway schemes for Moscow. It seems, according to H.M. Consul at that town, that the municipal authorities of that city purpose converting the present horse tramways of Moscow into electric tramways. The two tramway companies of Moscow have placed themselves in communication with two financial syndicates in Berlin and Dresden, and certain propositions have been made to the Mayor of the town—Prince Galitzin—who has referred the whole business to a special commission to draw up a report and furnish H.M. Consul with a statement of what is actually required. This document will not be ready for some months, but should the Mayor eventually receive tenders from British firms, he promises that the same will have careful attention from the Commission and exactly the same chance of being accepted as the tenders from other countries.

Richmond.—On Friday night a meeting of the Richmond Town Council was held, when objection was made to the scheme of the London United Tramways Company for an electric tramway to traverse Richmond—by a "back road" route—and Kingston to Hampton Court.

Rochester.—Last Friday an inquiry by the Light Railways Commissioners with reference to the application by a private company to establish a system of electric trams connecting New Brompton, Chatham, Rochester, Strood, and district, opened at Chatham. The two Town Councils and the Urban District Council of Gillingham are in favour of the project.

St. Helens.—Major Cardew, R.E., has been holding a Board of Trade inquiry into the application by the St. Helens Corporation for sanction to use electrical power on local tramways on the overhead system, and to the borrowing of £25,000 for purposes connected with the adaption of the line, &c., to electrical traction.

Switzerland.—The three-phase electric railway which is being built near Zermatt on the Gorner Grat was recently tested for the first time, in presence of the Swiss inspector of railways. The section just finished has a length of 1,600 m. and a gradient of 12 in 100. The experiments were very successful; the up and down journeys on the gradient were performed without difficulty; the full speed of the locomotives being maintained by the motors. The descent on the steepest part of the gradient was carried out with ease, with a fully load train. The new rack railway has a length of 9·8 km., and a maximum gradient of 20 in a 100. The power is taken from the Findelenbach, which drives four turbines of 250 H.P. each, coupled directly with three-phase dynamos of 5,000 volts and 40 periods per second. The voltage in the trolley wire is 550. Every locomotive carries two three-phase motors of 90 H.P. each, which are geared to the driving wheels by toothed gearing. The three-phase motors act as generators, and require as much power to drive them as they give out; if in the descent they are driven 2 to 3 per cent. above the speed of synchronism, the locomotive gives back power to the leads. When all the locomotives on the line are descending, the excess power given back is absorbed in a water resistance in the power station. The electric part of the installation has been carried out by Brown, Boveri & Co., and is on the system which this firm has used on the Lugano line. They have also applied the same system to the Jungfrau Railway, and are at present applying it to the line from Stanstaad to Engelsburg, which will be opened this year. The line from Burgdorf to Thun, in the canton of Berne, will also be built on the three-phase system by this same firm.

TELEGRAPH AND TELEPHONE NOTES.

Cape Town to Blantyre Telegraphs.—Mr. Cecil Rhodes received the following letter on 21st inst. from the Postmaster-General at Cape Town:—"Through telegraphic communication from Cape Town to Blantyre (British Central Africa Protectorate) was established yesterday (Wednesday). Congratulations." The distance between the two points exceeds 2,000 miles.

Communication with the Cape.—We learn from the *Cape Argus* of the 23rd ult., that during the period when the West Coast route was interrupted last month, at the same time that the Delagoa Bay-Natal cable was interrupted on the East Coast, messages from the Cape to London had to pass *viâ* the Transvaal. It can hardly be pleasant reading for many of the merchants, and others connected with the Cape, to know that they have to thank the South African Republic for affording them at that time the only means of transmitting their telegrams.

The Delays in Australian Telegrams.—In our various notices concerning the delays and interruptions to Australian trunk landlines, we find we omitted to mention that on Feburary 23rd last, "West Australian section: Owing to the presence of a hurricane between Israelite Bay and Eucla, that section of coastal line worked only simplex very badly; inland line also affected by heavy weather between Balladonia and Eucla, which prevented quadruplex working on this wire, fair duplex circuit available; our inward business suffered delay. South Australian section: Both lines worked duplex well till 10 p.m., when reduced to simplex; the new line worked badly, and the old wire fairly well till clear. Outward clear by West Australia 11.35 p.m. Outward clear by South Australia 2.30 a.m." From this it is clear that as regards the inefficiency of the South Australian, as compared with the West Australian landlines, there is little or nothing to choose; both appearing to be equally infirm; and yet it has been suggested that such lines as these should form a portion of the cable system which it was proposed to extend from London to Australia *viâ* the Cape of Good Hope.

A Pacific Cable.—An American exchange says that late advices from Honolulu announce that the Hawaiian Legislature is considering a Bill authorising the construction by the Pacific Cable Company of a cable between the United States and the islands. The Hawaiian Bill gives the company exclusive cable rights for 20 years. The cable must be laid within 18 months after the passage of the Act by the American Congress, and extended to Japan within three years. It must be capable of transmitting 15 words a minute, and the toll rate between Honolulu and San Francisco is not to exceed 35 cents a word, and to Japan it is not to exceed 90 cents a word.

Queensland and the Pacific Cable.—In a speech made last week at Brisbane by the Hon. T. J. Byrnes, the new Premier of Queensland, as to the past and future policy of the Government of that Colony, amongst other statements the speaker said: "He was thoroughly favourable to the Pacific cable, and the Government were prepared to take a strong lead in the matter." This is quite in accordance with the conclusions arrived at by the majority of the Premiers of the various Colonies at the recent conference held in Melbourne, where "It was resolved that if Great Britain and Canada each contributed one-third of the cost of the Pacific cable, New South Wales, Victoria, Queensland, and Tasmania would be in favour of contributing the remaining third. Mr. C. C. Kingston (South Australia) and Sir John Forrest (Western Australia) dissented from the resolution, expressing preference for the cable route *viâ* the Cape of Good Hope." The dissentient vote of the two latter is, of course, easily understood, as it is in the interest of the colonies which they represent to retain as long as possible control of European traffic, which at present passes over the landlines of South Australia and Western Australia; but it seems that, in view of the great frequency of interruptions to both lines, these gentlemen would have advanced the interests of Australia as a whole by voting with the majority.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	**April 6th, 1898 ...**	...
West Indies—		
St. Croix-Trinidad ...	**Nov. 30th, 1896 ...**	...
Cayenne-Pinheiro ...	March 24th, 1898 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	**May 5th, 1896 ...**	...
Obidos-Parintins ...	**Dec. 7th, 1896 ...**	...
Cable beyond Gurupa ...	April 4th, 1898 ...	
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	April 12th, 1898 ...	...
Cape Town-Mossamedes ...	„ 14th, 1898 ...	...
Maranham-Para	„ 17th, 1898 ...	...
Benguela-Mosoamedes ...	„ 20th, 1898 ...	...
Landlines.		
Trans-Continental line beyond Masol	**March 12th, 1896 ...**	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Saigon-Bangkok	April 20th, 1898 ...	April 20th, 1898
„ „	„ 21st, 1898 ...	„ 23rd, 1898
„ „	„ 24th, 1898 ...	„ 25th, 1898

The name of the company should be *Bermudas*, not Bermuda.

West African Telegraphs.—A Reuter despatch, dated Lagos, April 25th, says that telegraphic communication has been established between Lagos and the British post of Jebba, situated on the Niger a little north of the ninth parallel. The whole of the work through the Ilorin State has been successfully carried out on the Lagos side by Captain Turner, R.E., and Mr. Stone, of the Lagos Public Works Department.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen—The Council invites tenders for the supply and laying of about 10 miles of ·67 single core feeder cable, 5 miles of ·2 three-core network cable, and 3½ miles of arc lamp series cable. The cable is to be armoured and laid in wooden casing. Under another contract the Harbour Commissioners invite tenders for the supply and erection of 62 arc lamps and three leading lights, each

consisting of four arc lamps. All lamps to be Brockie-Pell or Crompton-Pochin. Both the contracts will have to be completed by August 31st, and particulars in both cases can be obtained from the Corporation Electricity Works, Cotton Street. See our "Official Notices" April 22nd.

Belgium.—May 31st. The Municipal Authorities of Ixelles, a suburb of Brussels, are inviting tenders until May 31st for the exclusive concession for the supply of electrical energy for lighting and power purposes during a period of 26 years, that is, to September 1st, 1924. Tenders to be sent to the Secretariat de la Commune d'Ixelles, Brussels, from whence particulars may be obtained.

Edinburgh.—May 6th. The Corporation wants tenders for the wiring of the St. Leonard's police station. Particulars from the resident electrical engineer, 5, Dewar Place, and see our "Official Notices" this week.

France.—May 5th. The French Post and Telegraph Authorities in Paris are inviting tenders until May 5th for the supply of about 139 kilometres of electric cables (gutta-percha insulated). Particulars may be obtained from, and tenders to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, Paris.

Great Eastern Railway.—May 12th. The directors invite tenders for the supply of stores and materials. For particulars see our "Official Notices" this week. Forms of application from the secretary's office, Liverpool Street Terminus, E.C.

Hyde.—May 5th. A Corporation Committee invites tenders for the supply and fixing of gas engine, dynamo, wires, fittings, &c., for electric lighting at the new technical school and free library. Engineers, Messrs. Lacey, Clirehugh & Sillar, 78, King Street, Manchester. See our "Official Notices" April 22nd for particulars.

London.—May 17th. The Bethnal Green Board of Guardians invites tenders for the supply of plant, and installing the electric light at the new infirmary, Palestine Place. Plans, &c., to be obtained from the architects, Giles, Gough & Trollope, 28, Craven Street, Charing Cross, W.C. See our "Official Notices" April 22nd for particulars.

Roumania.—April 30th. Tenders are being invited until the 30th inst. by the Roumanian Post and Telegraph Authorities in Bucharest, for the supply of 50 tons of galvanised iron wire, 10 tons of galvanised steel wire, and 5 tons of tinned copper wire. Particulars may be obtained from, and tenders to be sent to, La Direction Générale des Postes et Telegraphes, Bucharest, Roumania.

Sunderland.—April 29th. The Corporation is inviting tenders for the supply of a high-speed 225-kw. steam dynamo, and two Lancashire or Galloway boilers. Borough electrical engineer, Mr. J. F. C. Snell. See our "Official Notices" April 15th for particulars

Victoria.—June 24th. The Council of the city of Hawthorne (Colony of Victoria, Australia) is inviting tenders for the supply and erection of buildings, boilers, engines, dynamos, transformers, mains, meters, arc lamps, poles; also running the plant for three years. See our "Official Notices" March 11th.

West Ham.—May 10th. The Council wants tenders for certain electroliers, standards, &c., required for its public buildings. Mr. J. J. Steinitz, borough electrical engineer. See our "Official Notices" this week for particulars.

CLOSED.

Bournemouth.—The following is a list of the tenders sent in for supplying and fixing cables, conductors, lamps, columns, fittings, &c., for the lighting of the Bournemouth Pier and Lower Pleasure Grounds by electricity. F. W. Lacey, M.Inst.C.E, borough engineer and surveyor, can perhaps inform us how the enormous differences originate:—

	Pier installation.	Pleasure grounds installation.	Arc lamps for pier and square.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Crompton & Co., Limited ..	2,900 0 0	1,780 0 0	524 0 0	5,204 0 0
Johnson & Phillips	1,353 6 0	1,386 12 0	66 0 0	2,805 18 0
Brush Electrical Engineering Company	816 17 6	702 0 0	221 2 6	1,740 0 0
Laing, Wharton & Down, Limited	776 0 0	694 0 0	227 0 0	1,707 0 0
Leonard G. Tate	825 0 0	507 0 0	270 0 0	1,602 0 0
British Insulated Wire Company, Limited	725 4 7	532 0 2	326 10 0	1,583 14 9
Bournemouth and District Electric Supply Company	576 17 8	485 2 8	352 19 8	1,415 0 0
Cash, Robinson & Co. ..	588 3 0	472 0 0	192 14 0	1,252 17 0

The following were informal:—Scott, Anderson & Belt, R. Whipp & Co., Bow, McLachlan & Co., Mendham & Co., Lovell-Simons & Co., Fippard & Cooper, E. G. Bryant.

Leyton.—We understand that the Council has accepted the tender of Messrs. Siemens Bros. & Co. for the supply of dynamos at £737, that of Messrs. Wells Bros. for gas engines (£1,708) and that of Messrs. Laurence Scott & Co. for switchboards at £150. The buildings contract is in the hands of Mr. Coxhead. We gave particulars of the tenders last week.

Newcastle.—The Lunatic Asylum Visiting Committee of the Newcastle Corporation has considered the tenders for the installation of the electric plant for the lighting of the new extension at the asylum, and that of Messrs. Corlett & Company (£2,388) has been accepted.

Watford.—We understand that Mr. Henry J. Rogers, Watford, has received instructions to supply all the arc lamp columns and arc lamps for the Watford electric lighting scheme.

FORTHCOMING EVENTS.

1898.

Saturday, April 30th.—Association of Municipal and County Engineers at Wimbledon, 11.15 a.m. Paper by Mr. A. H. Preece, electrical engineer to the Wimbledon Council, on "The Works to be carried out for the Supply of Electrical Energy to the District"; at 4.15 p.m. the members will inspect the Conduit and Insulation Company's works at Summers Town, and a paper will be read by Mr. F. H. Bathurst on "Electric Wiring Practice."

Monday, May 2nd, at 8 o'clock.—Society of Arts. The first of a series of four Cantor lectures on "Electric Traction," by Prof. Carus Wilson.

Thursday, May 5th, at 8 p.m.—Chemical Society. Papers to be read:—"The Reactions of the Carbohydrates with Hydrogen Peroxide," by C. F. Cross, E. J. Bevan and Claud Smith; "The Properties and Relationships of Di-hydroxytartaric Acid," Part II., by H. J. H. Fenton, M.A.; "The Affinity Constants of Certain Hydroxy-Acids," by S. Skinner, M.A.; "Molecular Weights in Solution of Permanganates, Perchlorates and Periodates," by J. Murray Crofts, B.A., B.Sc.

Extra meeting of the Institution of Electrical Engineers, to be held at the Society of Arts, to hear a paper by Mr. Leonard Andrews, A.I.E.E., on "The Prevention of Interruptions to Electricity Supply." This arrangement was subject to the discussion on Messrs. Parshall, Cardew and Trotter's papers finishing last night.

Friday, May 6th, at 8 p.m.—The Institution of Junior Engineers at the Westminster Palace Hotel. Paper to be read and discussed:—"Evaporative Condensers and Independent Air-pumps for Same," by Mr. Harry Fraser (member).

Monday, May 9th, at 8 o'clock.—Northern Society of Electrical Engineers at Manchester. Paper by Mr. W. C. C. Hawtayne.

Friday, May 13th, at 5 p.m.—Physical Society. Paper on "Galvanometers," Part II. By Prof. W. E. Ayrton and Mr. T. Mather.

NOTES.

Institution of Civil Engineers.—At the annual general meeting of the Institution of Civil Engineers, held on April 26th, Sir John Wolfe Barry, K.C.B., president in the chair, the result of the ballot for the election of officers was declared as follows:—President, Mr. W. H. Preece, C.B.; vice-presidents, Sir Douglas Fox, Mr. James Mansergh, Sir William Anderson, K.C.B., and Sir William White, K.C.B.; other members of council:—Mr. James Barton (Dundalk), Mr. Horace Bell, Sir Alexander Binnie, Mr. Thomas Forster Brown (Cardiff), Mr. Henry Deane (Sydney), Mr. W. R. Galbraith, Mr. George Graham (Glasgow), Mr. J. C. Hawkshaw, Mr. Charles Hawksley, Mr. G. H. Hill (Manchester), Dr. Hopkinson, Mr. J. C. Inglis, Mr. Alexander Izat (India), Dr. Alex. B. W. Kennedy, Mr. John Kennedy (Montreal), Sir James Kitson, Bart., M.P. (Leeds), Mr. A. G. Lyster (Liverpool), Mr. William Matthews, Sir Guilford Molesworth, K.C.I.E., Sir Andrew Noble, K.C.B. (Newcastle-on-Tyne), Mr. Alexander Siemens, Mr. Thomas Stewart (Cape Town), Mr. F. W. Webb (Crewe), and Sir Leader Williams (Manchester).

Institution of Electrical Engineers.—Before this Institution last night papers were read on "Earth Returns for Electric Tramways," by H. F. Parshall, member; and "Notes on Electric Tramways," by Major P. Cardew, R.E., and A. P. Trotter, members.

Cables in War Time.—In the House of Commons on Tuesday Mr. Nussey (Pontefract) asked the First Lord of the Treasury whether he could inform the House if either belligerent had the right, and if so to what extent, to interfere with cables between the territory of the opposing power and any other part of the world. Mr. Balfour in reply said: "A convention, to which Great Britain, Spain, and the United States were parties, was concluded at Paris on March 14th, 1884, providing for the protection of submarine cables. But by Article XV. thereof in time of war a belligerent signatory to the convention is free to act with respect to submarine cables as if the convention did not exist. I am not prepared, therefore, to say that a belligerent, on the ground of military exigency, would, under no circumstances, be justified in interfering with cables between the territory of the opposing power and any other part of the world."

The *Times* concludes a leader on the war by some remarks on the fate of the cables. The article says:—

> Messrs. Eyre & Spottiswoode write to us to-day quoting a decision that they are commercial property, not liable to seizure, or at least to destruction, even if they carry war messages among others. But Mr. Balfour last night, in reply to a question, quoted a convention to which England, Spain, and the United States were parties, providing for the protection of submarine cables, yet reserving to a belligerent the right to treat them as if the convention did not exist. It seems, therefore, to be an open question what is the precise position of submarine cables under existing usages, though there can be none as to the position that ought to be assigned to them in conformity with the spirit of the Declaration of Paris. As the Power which can cut them can generally tap them and stop all messages injurious to its interests, there seems the less reason for exempting this form of neutral property from the protection of the neutral flag.

A telegram published early in the week in the *New York Herald* from its special correspondent at Key West says:—"The United States lighthouse tender *Mangrove* has picked up the cable between Havana and Key West. All the despatches passing over the cable to or from the Cuban capital are being read. The Government now has its own operators in Key West and a cable office. All despatches are subjected to censorship."

The Postmaster-General on Tuesday notified that telegrams for all places in Cuba by the North American cables, *via* Key West, must be handed in at telegraph offices under the control of the British Post Office, written in plain language, and will be accepted only at the sender's risk.

The Physical Society.—Before this Society on Friday last, Dr. S. P. Thompson exhibited a model apparatus made by the Helios Company, to illustrate the three-phase method of transmitting power. It consists of a small generator, driven by hand, and a small motor. The generator is separately excited by a small secondary battery; it has three independent coils. The six ends of the coils are connected to six commutator rings. The motor has three corresponding pairs of opposite coils; these can be grouped in various ways for connection to the brushes of the generator. The six coils are on a hinged frame, so that, if necessary, they can be laid down flat for other rotation experiments. Two armatures are provided, either of which may be used. The first is an iron wheel, with peripheral copper bars arranged like a squirrel-cage; the other is a simple iron disc, without added conductors.

Electric Wiring at Buenos Ayres.—The editor of the *Review of the River Plate* recently inspected several electric lighting installations carried out for some private houses in Buenos Ayres by Messrs. Rufino Varela (hijo) & Co., and found that in nearly every instance the entire installations were being made without a single joint in the wires. This, says the writer, is certainly a move in the right direction, as joints, as a rule, are the initial cause of all trouble in these installations. In many cases they are either not soldered, or else the work is scamped; then they are badly insulated; very often the wire is burnt by careless workmen, and breaks whenever any strain is placed upon it. This jointless work has, in our contemporary's opinion, a great advantage over all others, as it does away with the primary cause of outbreaks of fires, keeps up the insulation resistance, and the special fittings used for branches are strong and neat, and the work easily lends itself to inspection and revision in case of faults.

Municipal Authorities and Electric Lighting.—On Monday a conference of municipal authorities of England and Scotland, convened by the Municipal Electrical Association, was held at the Westminster Palace Hotel, to ascertain their views as to what course should be taken before the Joint Committee of the two Houses of Parliament, which is now considering the question of electrical energy, generating stations, and supply within extensive areas, and has agreed to certain clauses. Manchester, Wolverhampton, and Glasgow had already agreed to take common action, and the representatives of the other municipalities on Monday agreed to support the course that they had decided to take before the Select Committee, and that their interests should be represented by Mr. Worsley-Taylor, Q.C., Mr. Pritchard, Q.C., and Mr. Lewis Coward. After debate, the conference unanimously decided that, notwithstanding the provisions of the Electric Lighting Act, 1882, powers should be given to municipalities for acquiring land compulsorily for generating stations, and that as to liability for nuisance and notices to owners, they should be under the same statutory powers as railway companies as to their liability for compensation or damages for neglect; that compulsory powers should be given for acquiring land for generating purposes not within the area of supply; that power should be given for breaking up streets between the generating station and the boundary of the area of supply; that powers should be given for the supply of electrical energy over an area including districts of numerous local authorities, with the consent of such authorities; and that powers ought to be conferred upon promoters seeking to supply electrical energy "to other undertakings, and not directly to consumers," with the consent of the local authorities.

Röntgen on the Röntgen Rays.—Such a host of investigators have devoted themselves to the development of Prof. Röntgen's great discovery, that it would be no matter for surprise if there was nothing left for the discoverer to find out about his own discovery. Some novel properties of the X rays, however, have been described by Prof. Röntgen in a third communication on this subject to the Berlin Academy. Among these the following appear to be especially interesting. If a fluorescent screen is covered with a plate completely opaque to the X rays, a slight fluorescence can nevertheless be seen when the tube is in action. Röntgen has shown that this is due to rays proceeding from the air of the room, which emits X rays wherever it is itself exposed to their action. This fact points to the necessity of placing photographic plates in a sheath of lead when used for long exposures, to prevent them being fogged by diffused rays from the back or sides. Of the rays which are given off by the platinum plate of a focus tube, those are most effective for producing pictures which leave the platinum at as great an angle as possible, within a limit of 80°. The specific transparency of bodies is greater the thicker the body. The ratio of the thicknesses of two equally transparent plates of different material is dependent on the thickness and the material of the medium through which the rays have to pass before they reach the plates. For instance, the ratio of the thickness of platinum and aluminium plates of equal transparency will be reduced to one-half if the rays are passed through a thick glass plate before they strike the metal plates. Röntgen, like Swinton and others, has shown that the contrast between bodies of different transparencies depends on the E.M.F. used to excite the tubes. A spark gap in the secondary circuit acts in the same way as an intercalated Tesla transformer; both produce more intense and less easily absorbed rays. By the use of a Tesla transformer and wire electrodes in a narrow tube, X rays can be produced with a vacuum of 3·1 mm., the usual vacuum being, of course, about 0·0002 mm. Hard tubes, as Röntgen calls those tubes which require a very high E.M.F., can be softened, as is well known, by heating, or by re-admission of air, or, as is not so well known, by heating limetree charcoal placed in a side tube, or by sending through the tube a very powerful discharge. The composition of the rays given off by the platinum anti-cathode depends essentially on the time change of the discharge current. The quality of the rays is not affected by the change of the primary current, but their intensity is proportional to the strength of the primary current.—*Elektro-Zeit.*, 19, p. 192.

Auxiliary Wastes.—The Chicago Electric Traction Company are now alive to the saving in substituting electric motors for steam in driving auxiliary plant. Their large engines developed 217 H.P. on a water consumption of 3,903, or at the rate of 18 lbs. per I.H.P.-hour. The small engines used steam as follows:—

Economiser engine	...	38·4 lbs. per hour.
Stoker engine ...	...	36·4 „
Air and feed pumps	...	685·0 „

The total is 759·8 lbs. per hour, or nearly 20 per cent. of the consumption of the main engines. While true that the exhaust went to heat the feed, the *Street Railway Review* says this was the function of the economiser, and it is scarcely an economy after all to employ a wasteful engine as a feed heater, when unavoidably wasted furnace products are available for the purpose.

Oil Fuel.—Oil fuel has been used for several weeks past at the Chicago Elevated Power Station, one of the 2,000-H.P. units having been run six hours daily on oil fuel. Storage tanks and pumps, with duplicate pipes, are completed.

Exhibition of Acetylene Apparatus.—The Executive Council of the Imperial Institute has on foot a scheme for holding an exhibition of acetylene gas generators and illumination by acetylene gas. The generators admissible are divided into three groups, viz., (1) those in which the gas is generated by water being allowed to drip, or flow in a small stream, on to the top of the carbide; (2) those in which water rises round the carbide; (3) those in which the carbide falls into the water; these being again sub-divided into automatic and non-automatic. Forms are being sent out for applications for space; but the Council will not undertake to hold the exhibition unless, by May 2nd, there is a sufficient number of applicants to cover the actual outlay which will be involved.

Street Lighting at Buenos Ayres.—The streets of the city of Buenos Ayres are at last to be lighted by electricity, as the municipality has accepted, says a River Plate exchange, the tender presented by the Compania General de Electricidad de la Ciudad de Buenos Ayres. To commence with, 300 8-ampere lamps are to be installed in various districts. The prices are:—120 lamps, burning all night, at $27 each, $3,240; 180 lamps, burning up to 1 a.m., at $20.25 $^{m}/_{n}$ $3,645. Total, $6,885 per month. The saving under this arrangement as compared with the gas bill is expected to be considerable.

Electric Motor Printing Presses.—The *Electrical Age* says that the largest printing press ever built is being driven by a Crocker-Wheeler motor. This press was constructed by R. Hoe & Co., and is an octuple, stereotype perfecting press and folder. It prints, folds, counts and delivers 96,000 eight-page newspapers in an hour. A 75 horse-power motor built by the Crocker-Wheeler Electric Company, of Ampere, N.J., and New York, has been installed under the floor for direct connection to the gigantic press above it.

Steam Engine Trials.—At the South Western Polytechnic, Chelsea, S.W., a special class in "Steam Engine Trials," intended for draughtsmen and advanced engineering students, will be conducted by Prof. Pullen, Wh.Sc., A.M.I.C.E., and Mr. H. A. Clark, Wh.Sc., A.I.E.E., on Tuesday evenings, from 7.30 to 10 p.m., commencing May 17th and terminating June 28th, 1898. Inquiries to the head of the engineering department.

Gas Producer Feeding.—The importance of even feeding of gas producers is insisted upon by Mr. Bildt in a paper to the American Institute of Mining Engineers. The familiar hopper and cone introduces large masses of fuel suddenly into the producer, generating large volumes of gas at one time, while at another the gas becomes small in quantity and there will be excess of air with formation of carbonic acid, or when the gas is used in furnaces, oxidation of the metal from excess of oxygen. The cone is, moreover, an uneven distributor, depositing more fuel on one side than on another, and variable gas results. An ideal feeding device should be continuous in action, feeding just so much coal as will yield the gas required in a given time, and it should evenly distribute the coal over the surface of the already deposited fuel so as to give an even resistance to the rising column of air in order to prevent uneven action. The author has patented a device consisting of a spiral revolving in the upper part of the producer, and receiving coal through a shoot and slide. The description of the revolving spiral and its action is not very clear. Analyses are given of two gases, one from a producer using little water, the other from a steam-blown producer, which shows a large percentage of hydrogen and a very much smaller percentage of nitrogen. One is cited as from Domnarfoet, the other from the Washburn and Moen Manufacturing Company. They are as follows:—

	Domnarfoet	Washburn.
CO	2·00	4·90
O	0 10	*nil*
CO	27·90	26·80
C_2H_4	0·10	0·40
H	2·60	18·10
CH_4	...	3·50
N	67 60	46·30
	100 00	100 00
Percentage combustible	30·60	48 80

In the steam-blown furnace some of the CO has been made from oxygen produced by decomposing the steam jet. This, of course, saves using so much air, and reduces the nitrogen, thus producing a much richer and more combustible gas, as well as utilising the heat of conversion of carbon into monoxide to dissociate the steam. If the result is a cooler gas an economy will have been effected, but there is evidently a greater production of CO_2 with the steam jet, which, however, may not be due to this.

Presentation.—On Saturday last the staff of the King's Road Central Station, St. Pancras, presented a testimonial to Mr. H. R. Burnett (who is leaving the service to take up the position of borough electrical engineer at Barrow-in-Furness), consisting of a silver stop watch with suitable inscription. The presentation was made by Mr. Sydney W. Baynes (chief electrical engineer).

Lecture.—A lecture on "Wireless Telegraphy," with experimental illustrations, will be given on Wednesday, May 4th, at 8 p.m., also on Thursday, May 5th, at 8 p.m., at the Skinners' School for Girls, Stamford Hill, by Mr. J. E. Taylor. The proceeds are to be devoted to the Hackney Technical Institute movement.

The Spiral Globe, Limited.—We understand that within a few days the public will be asked to subscribe to the capital of a company with the above title. The spiral globe is a new form of lamp reflector, consisting of a closely-wound spiral of small glass rod around the bulb of the incandescent lamp. As a means of increasing the effective illuminating power of the lamp, it has been favourably reported upon by Mr. Hugh E. Harrison, Mr. W. H. Preece, and Mr. F. J. Down, the latter of whom ventures to estimate the company's probable sales at 2 million lamps per annum, and its profits at not less than £26,000.

Obituary.—We hear with regret of the death of Mr. George Greenwood, of the well-known firm of Greenwood and Batley, of Leeds, which occurred at his London residence on 16th inst. Mr. Greenwood was 57 years of age. Ten years ago, when the business was turned into a limited company, the deceased gentleman came to London and acted here as managing director. Mr. Greenwood was a member of various institutions, including the Institution of Civil Engineers.

Early Electrical Appliances.—We understand that by request of the secretary of the Institution of Civil Engineers, Mr. Killingworth Hedges, of Emery Hill Street, Ashley Gardens, Westminster, is gathering together, for the purpose of an exhibit at the May Conversazione, a representative collection of early electric lighting appliances used from about 1876 to 1886, excluding large objects, such as dynamos. This is, we understand, in honour of the new president, Mr. W. H. Preece, C.B., &c., and if successful, we believe the exhibit may take a permanent form. Mr. Hedges will be glad to receive exhibits, and to hear from all who are able and willing to render any assistance in this matter.

Davy Davies Hoisting Gear.—The Davy Electrica Construction Company write "to thank Mr. Ernest Kilburn Scott for his good opinion of the Davy Davies patent hoisting gear" in our last issue. "The gear, as illustrated," they say, "is merely one of our methods of carrying out the invention, and we see no difficulty in applying the gear to all kinds of street and private arc lighting."

NEW COMPANIES REGISTERED.

Lancashire Electrical Engineering Company, Limited (56,992).—Registered April 19th, with capital £5,000 in £1 shares, to acquire the business carried on by J. McDermott, J. E. Taylor, and W. Barratt at Volt Works, Old Street, Ashton-under-Lyne, as "The Lancashire Electrical Engineering Company," to adopt a certain agreement, and to carry on the business of electrical engineers, electricians, millwrights, &c. The subscribers (with one share each) are:—J. McDermott, Old Street, Ashton-under-Lyne, electrical engineer; J. E. Taylor, 40, Bentwick Street, Ashton-under-Lyne, electrical engineer; W. Barratt, 175, Old Street, Ashton-under-Lyne, electrical engineer; J. J. O'Connor, 28, Rycroft Street, Ashton-under-Lyne, electrician; J. Barratt, Trafalgar Street, Ashton-under-Lyne, engineer; W. Barratt, 132, Hyde Road, Gorton; C. Wilson, 27, Egerton Street, Higher Openshaw, pattern maker. The number of directors is not to be less than two nor more than three; the subscribers are to appoint the first; qualification, 50 shares. Registered office, Volt Works, Old Street, Ashton-under-Lyne.

Electric Horse Promotion Syndicate, Limited (56,996).—Registered April 19th, with capital £5,000 in £1 shares, to adopt an agreement with J. Lambert and to promote or assist in promoting a company for the acquisition of certain undescribed patents and inventions. The subscribers (with one share each) are: E. Kaiser, 131, Earl's Court Road, Kensington, clerk; A. J. Biss, 53, Elizabeth Street, Walworth, clerk; W. C. Ponsford, 6, Upper Tollington Road, N., clerk; H. Harman, 11, Charing Cross, S.W., clerk; L. Kelsey, 101, Victoria Road, Kilburn, theatrical manager; H. Lack-Szyrma, Barkingside, Ilford, solicitor; A. Trow, 46, De Beauvoir Road, N., accountant. Registered without articles of association by Chapronière & Co., 11, Charing Cross, S.W.

Lancashire Light Railways Company, Limited. (57,018).—Registered April 21st, with capital £50,000 in £1 shares, to construct, purchase, lease, contract for or otherwise acquire, equip, maintain, and work light railways and tramways in Lancashire or elsewhere, and to carry on the business of electricians, engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are:—J. B. Atherton, Manhattan, Gateacre, Lancashire, manufacturer; F. J. Leslie, 15, Union Court, Liverpool, solicitor; W. M. M. Forwood, 15, Union Court, Liverpool, solicitor; C. O. Grindrod, 11, Knowsley Road, Rock Ferry, Cheshire, gentleman; A. E. Haptie, 5, Durham Road, Seaforth, Liverpool, cashier; A. Ruckley, 8, York Road, Seacombe, Cheshire, clerk; J. G. Setterfield, 16, Thorndale Road, Waterloo, clerk. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £200; remuneration as fixed by the company. Registered by F. J. Leslie and Company, 15, Union Court, Liverpool.

Sphere Lighting Company, Limited (57,040).—Registered April 22nd, with capital £12,000 in £1 shares, to adopt an agreement with F. Gallsworthy, to acquire any inventions, patents and rights, for the lighting of billiard tables and rooms by electricity or otherwise, and to carry on the business of billiard table and requisite manufacturers, electricians, electrical, mechanical, and metallurgical engineers, &c. The subscribers (with one share each) are:—F. Gallsworthy, 17, Wellington Street, Leeds, leather factor; J. Gordon, 1, Bond Street, Leeds, chartered accountant; J. M. Barwick, 24, Basinghall Street, Leeds, solicitor; A. C. Peake, 24, Basinghall Street, Leeds, solicitor; E. O. Simpson, 47, Albion Street, Leeds, solicitor; T. H. Cooper, Great Northern Hotel, Leeds, manager; G. H. Hebblethwaite, Westroyd, Mirfield, belt manufacturer. The number of directors is not to be less than three nor more than seven; the first are C. E. Bulling, F. Gallsworthy, J. Gordon, G. H. Hebblethwaite, A. C. Peake and E. O. Simpson; qualification, £100; remuneration as fixed by the company. Registered office, 47, Albion Street, Leeds.

CITY NOTES.

Huddersfield Corporation Electricity Works Accounts.

Probably the best way of showing the sound and steady progress that is being made at the Huddersfield Municipal Electricity Works is to reproduce the comparative statement which is included in the abstract of accounts for the year ending December 31st, 1897. From a fairly heavy deficiency of £2,547, which was encountered at the end of the first year's work (1893), the management has been able to show a very substantial profit, after providing for interest and contribution to sinking fund.

The following table gives the cost per unit:—

	1897.	1896.
Total capital expended	£69,415	£58,117
Number of units sold	438,848	304,163
Number of lamps connected	41,702	28,983
Revenue from sale of current	£8,533	—
Net revenue	£4,964	—
Average price obtained per unit	4·66d.	—

Cost of production.	£		Per unit.	1896.
Coal	901		·49d.	—
Oil, waste, water, and engine room stores	104		·06d.	—
Salaries and wages at generating station	985		·54d.	—
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	794	Works' cost 1·52d.	·43d.	—
Rent, rates and taxes	311		·17d.	—
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	1,001		·55d.	—
Depreciation of buildings and plant account	—		—	—
Renewal fund account	—		—	—
Total	£4,096		2·24d.	—

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	8,533	0	0	4·66d.
Meter rents, &c.	458	0	0	—
Supply of steam	—			—
Transfer fees	—			—
Other items	69	0	0	—
Total	£9,060	0	0	4·66d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·24d.; works' cost, 1·52d.

Comparative Annual Statement from the Commencement of the Undertaking.

Year ended.	No. of consumers.	No. of 8-C.P. lamps connected.	B. T. units sold.	Income.	Expenditure.	Balance.		
						Deficiency paid from borough fund.	Surplus.	Rate in £.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.
Dec. 31st., 1893 ..	112	9,613	43,224	1,067 3 11	3,614 11 8	2,547 0 0	...	$1\frac{9}{16}$
„ 1894 ..	214	15,342	156,169	3,560 8 7	5,625 13 4	2,065 0 0	...	$1\frac{1}{8}$
„ 1895 ..	280	20,889	227,753	5,351 5 0	6,724 9 0	1,373 0 0	...	$0\frac{7}{8}$
„ 1896 ..	385	28,933	304,163	6,864 2 5	6,429 13 4	...	434 9 1	Transferred to depreciation and contingencies account £1,618 9 1
„ 1897...	598	41,7 2	438,848	9,060 12 1	7,876 12 1	...	1,184 0 0	

Submarine Cables Trust.

The twenty-seventh ordinary annual meeting of the certificate holders of this trust was held on Wednesday at Winchester House, Old Broad Street, the Marquis of Tweeddale presiding.

The Chairman, in moving the adoption of the report of the trustees, said, that the revenue for the past year amounted to £22,997, being an increase of £105 over the previous year. Only £3,300 of the dividend to be received from the Eastern Extension Company for the quarter ending December 31st had been brought into the present revenue account, instead of the full quarter's dividend, as in former accounts. The total dividend and bonus for that quarter would amount to £4,315 7s., as in former years, so that, had they taken credit for the whole sum, the increased revenue would have been £1,120 instead of £105. At one time the December quarter's dividend was generally received before the closing of their books on April 15th in each year, but latterly it had not been received until the end of April or the beginning of May, in consequence of the half-yearly meeting of the Extension Company being held somewhat later than it used to be. It was hoped, however, that next year they might be able to pay the two coupons in full upon the due date without bringing in such a large portion of that interest, and the trustees looked forward to the time when the interest could be left out of the revenue account altogether until it was actually earned. The total expenses for the year had amounted to £1,159, which was an increase of £96 over the previous year. That was principally due to the extra cost of printing new notes for each of the existing 3,381 certificates. Notwithstanding that unavoidable expense, it would be observed that the total expenses were considerably less than was provided for by the trust deed. Coming to two principal features in the past year, the first was their return to the payment in full of each half-yearly coupon, and the second the completion of the sale of the Anglo-American Company's deferred stock, and the re-investment of the proceeds in dividend-paying securities. The reduction in the rate of the annual dividend which took place in 1885 prevented them from meeting certain coupons on their due dates. Between 1888 and 1891 they were one coupon behind, but since the latter date they had been able gradually to recover the lost ground, and for the last seven years they had paid an average of £6 8s. 7d. per cent., and therefore they had at last reverted again to the payment in full of the two last coupons on their respective due dates, which was a matter on which all connected with the trust were entitled to be congratulated. The proceeds of the sale of the Anglo-American deferred stock had amounted to £69,200, and the money had been invested in other securities of the character approved by the trust deed, and as the securities covered a wide area he thought they gave greater security to the trust. As showing the satisfactory position of the trust he might say that their investments showed an average appreciation of over 75 per cent.

Mr. J. Denison Pender seconded the motion, and the report was adopted.

The retiring auditors having been re-elected, the proceedings terminated with a vote of thanks to the chairman for presiding.

The Calcutta Electric Supply Corporation, Limited.

The first report of directors, to be presented at the annual general meeting of the shareholders of the company at the City Terminus Hotel, Cannon Street, in the City of London, to-day, at 2 o'clock p.m., states that immediately upon the formation of the corporation, instructions were given to the managing agents in Calcutta to negotiate for the purchase of a site upon which to erect the generating station. After some little time a suitable site was acquired; but owing to the fact that the land was covered with native buildings, and to the necessity for the vendors in some cases taking ejectment proceedings to get rid of the occupiers, the corporation has only just recently obtained possession of the site. The question of the use of overhead wires in some of the streets of Calcutta has involved very protracted negotiations with the Government of Bengal, the Telegraph Department, and the Municipality of Calcutta. These negotiations have recently been concluded, so far as to permit of the contractors making arrangements for shipping the necessary cables. Now that the site for the generating station has been obtained, the contractors have entered into sub-contracts for the erection of the buildings and chimney; the whole of the cables and copper for the mains have been ordered, and a good portion of the generating plant is well advanced towards completion, so that shipment can be made immediately the buildings are ready to receive the plant. The question of the renewal of the company's concession at the expiration of the period for which it was originally granted, viz., 21 years, for a further like period, has been the subject of negotiation with the Government, and the directors have no reason to doubt that the assurance, given to the company before the issue of the prospectus, will be carried out. The auditors, Messrs. J. H. Duncan & Co., appointed by the board in the first instance, offer themselves for re-election.

The Oriental Telephone and Electric Company.

The fourth ordinary general meeting of this company was held at Cannon Street Hotel on Wednesday, Mr. William Addison presiding.

The Chairman said that the net profits exceeded those of the previous year by £1,000. The expenditure had increased by the removal of the exchange to a more central position, and providing a new switchboard. They might expect similar expenses to arise. The rate of exchange had been more favourable to them than it had been for the past seven years. Business all round had been making steady progress, and the electric lighting had turned the corner. They were hopeful that the business already secured would show a fair profit. They would remember that the board had built up a reserve fund of £12,000, which was still intact, but owing to reconstruction could not be touched. They now suggested that a new reserve fund should be made to meet contingencies, repairs, and extending buildings and plans.

The report was then adopted.

Sir Auckland Colvin was re-elected a director in the place of Mr. Frost, a retired director, who did not seek re-election.

Stock Exchange Notices.—The Stock Exchange Committee have (1) appointed special settling days as under:—Thursday, May 5th.—Babcock & Wilcox, Limited—further issue of 8,000 ordinary shares of £10 each, fully paid, Nos. 14,001 to 22,000; South London Electric Supply Corporation, Limited—further issue of 9,159 shares of £5 each, £2 paid, Nos. 55,842 to 65,000. And (2) ordered the undermentioned securities to be quoted in the Official List:—Babcock & Wilcox, Limited—4,666 vendors' ordinary shares, Nos. 1 to 4,666, 3,333 vendors' 6 per cent. cumulative preference shares, Nos. 1 to 3,333, and a further issue of 8,000 ordinary shares, Nos. 14,001 to 22,000; Chelsea Electricity Supply Company, Limited—further issue of 8,000 ordinary shares, Nos. 32,501 to 40,500; House-to-House Electric Light Supply Company, Limited—further issue of 5,661 ordinary shares, Nos. 10,101 to 15,761; South London Electric Supply Corporation, Limited—further issue of 12,500 ordinary shares of £5 each, £2 paid, Nos. 43,342 to 55,841, and a further issue of 9,159 shares of £5 each, £2 paid, Nos. 55,842 to 65,000.

Eastern Extension Telegraph Company.—Subject to confirmation by the shareholders, the directors have declared a dividend for the quarter ended December 31st last of 2s. 6d. per share, together with a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year 1897. The dividend and bonus will be paid on May 12th.

West India and Panama Telegraph Company, Limited.—The directors recommend a dividend for the six months ended December 31st of 6d. per share on the ordinary shares.

The City of London Electric Lighting Company, Limited.—Mr. George Herring has been elected a director of this company in place of the late Lord Suffolk.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending April 22nd, 1898, were £2,609 18s. 8d.; corresponding period (Easter week), 1897, £2,963 9s. 10d.; decrease, £353 16s. 2d.

The City and South London Railway Company.—The receipts for the week ending April 24th, 1898, were £998; week ending April 25th, 1897, £928; increase, £70; total receipts for half-year, 1898, £17,769; corresponding period, 1897, £17,612; increase, £157.

The Dover Corporation Electric Tramways.—The receipts for the week ending April 23rd, 1898, £125 18s.; total receipts to April 23rd, 1898, £1,821 2s. 2d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for week ending Friday, April 22nd, 1898, were £576 13s.; corresponding week last year, £883 0s. 7d.; decrease, £306 7s. 7d.; passengers carried, 92,160; corresponding week last year, 117,731; aggregate to date, £6,892 1s. 5d.; aggregate to date last year, £7,117 5s. 3d.; decrease to date, £225 3s. 10d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending April 24th, 1898, amounted to £1,452; corresponding week last year, £1,770; decrease, £318. 1897, includes Easter Monday.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending April 22nd, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,964.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, April 20th	Closing Quotation, April 27th.	Business done during week ended April 27th, 1898. Highest.	Lowest
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	...	...	100 —104	100 104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	7 — 8	7 — 8	...	...
125,000	Do. do. 5% Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 9s.	£2 13s.	3 %	59 — 62xd	59 — 62	60	59
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s.	£5 6s.	6 %	109½ 110½xd	109 - 110	109¾	108½
3,038,020£	Do. do. Defd.	Stock	...	...	...	12 — 12½	12½ — 13	12¾	11⅞
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	7 %	16 — 16½	15⅞ 16¼	16	15⅞
75,000£	Do. do. 5 %, Debs., 2nd series, 1925	100	5 %	...	...	112 116	112 116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	4 %	4 %	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	8 %	...	175 —185	155 —195	...	...
918,297£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	104½	103½
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	2 %	...	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	7 %	6½ — 7½	6 — 7	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½ — 15½	14 — 15	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	4½ %	103 —106%	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2½%	2½%	...	10¼ - 10⅝xd	10 — 10½	10 5/16	10
120,000	Direct West India Cable 4½% Reg. Deb	100	...	...	...	99 —102	93 —101	100	99
400,000	Eastern Telg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17¼ 7¾xd	16⅞ 17¼	17½	16¾
70,000	Do. 6 % Cum. Pref.	10	6	6%	...	8 1⅜ xd	18 19	18½	18
89,900	Do 5 % Debs., repay. August, 1899	100	5 %	5%	...	100 103	100 103	...	...
1,302,615	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4%	...	127 130	125 129	125	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7⅛	7 ⅛	18¼ 18⅜	17½ - 18¼	18⅜	17¾
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,849, 3,976 to 4,325	100	5 %	5%	5 ⅝ 5 %	99 103	99 103	...	...
100,500£	Do. do. Bearer, 1,850—3,975 and 4,327—5,400	100	5 %	5%	...	100 —103	100 —103	...	...
320,000£	Do 4 % Deb. Stock	Stock	4 %	4%	4 %	127 130	127 —130	...	...
35,100	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5%	...	99 —103	100 103	...	...
46,500	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5%	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1900	100	4 %	4%	...	102 —105	102 —105	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4%	...	107 —110%	107 -110 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	...	11½ - 12	11¼ - 11⅝	11 11/16	11
180,042	Do. do. 6 % Pref.	10	6 %	6%	...	17½ - 17⅝	16½ - 17½	17½	16¾
150,000	Great Northern Teleg. Company of Copenhagen	10	10 %	10%	10 %	29½ - 30½	29 — 30	...	...
160,000£	Do. do. do. 5 % Debs.	100	5 %	5%	5 %	100 - 103	100 —103	...	...
97,000	Halifax and Bermuda Cable Co., Ltd., 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	95 —100	95 —100	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10%	...	52 — 55	52 — 55	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs. ...	100	6 %	6%	...	106 - 109	106 —109	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	4 %	2 — 2½	2 — 2⅛	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5⅛%	5⅛%	6 %	5⅛ - 6	5 — 5½	5⅜	5½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 - 18	15 — 17	16⅛	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½ - 6	5 — 5⅛	5⅜	5¼
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½ %	100 —105	100 —105	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝ ¾	⅝ - ¾	11/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	105 108	105 108	...	...
11,839	Reuter's Ltd.	6	5 %	5 %	...	8 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	..	...	136 141xd	136 -141	...	..
58,000	United River Plate Teleph., Ltd.	5	4 %	5 %	...	4 — 4½	4 — 4½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	105 —108	105 - 108	107	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	nil	...	3½ - 4½	3½ - 4½	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	99 —102	99 -102	100½	...
64,269	Western and Brazilian Teleg., Ltd.	15	3 %	2 %	...	11⅝ - 12¼	11½ — 12	11 3/16	11½
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	7½ - 8	7½ - 8	7⅞	...
33,129	Do. do. do. Def. Ord	7½	1 %	nil	...	4½ - 4⅝	4½ - 4⅝	4⅝	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	106 —109	106 —109	108	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	1 %	...	⅛ — ¼	⅛ — ¼	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	7¼ — 7⅝	7 — 7½	7¼	7 3/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	5 — 7	5 — 7	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600 ...	100	5 %	5 %	...	105 —108	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7%	...	105 —110	105 —110	...	...
160,100£	Do. do. 6 % Ster. Bonds.	100	6 %	6%	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	6 %	7 %	13½ — 14½	13 — 14	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	6 %	10 — 11	9½ — 10½	10	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	4½%	4½%	4½%	115 —117	115 —117	...	...
50,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001— 90,000	10	5 %	7 %	10 %	26 — 27	25½ - 26½	26½	25⅝
10,000	Do. do. Prov. Certs. Nos. 90,001 to 100,000 £5.	10	...	...	...	19 — 20	17½— 18½	18	17½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17½ — 18½	17½— 18½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —134	129 —134	...	...
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—30,000	10	nil	nil	nil	14½ — 15	14 — 15	14⅞	14½
10,000	Do. do. do. Nos. 30,001 to 40,000 £4 pd.	10	...	...	...	... ...	8½— 9	...	...
20,000	Do. do. do. 6% Pref., 40,001—60,000 ...	10	6 %	6 %	6 %	15½— 16	15 — 16	15⅞	15 13/16
17,400	Edmundsons Elec. Corp., Ld., ord. shares 1—17,400 £4 pd.	5	...	...	...	3½— 3⅝	4 — 4½	4	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5			4 %	10 — 11	10 — 11	...	...
10,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	11 — 12	11 — 12	...	...
62,400	*Metropolitan Electric Supply, Ltd., 101 to 62,500 ...	10	4 %	5 %	6 %	18 — 19	17½ — 18½	18¼	17⅞
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	117 — 121	117 —121	117	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	2 %	4 %	6 %	19½— 20½	19 — 20	19⅞	19½
31,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord.	5	7½%	10½%	14½%	17½— 18½	17½— 18½	18	17⅝
20,000	Do. do. 7 % Pref., 20,001 to 40,000	5	7 %	7 %	7 %	10 — 11	10 — 11	...	..
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	4 %	107 —110	107 —110	...	..
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2½— 2⅝	2½— 2⅝	2⅝	2⅝
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	16½— 17½	16½ — 17½	16⅝	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, April 20th.	Closing Quotation April 27th.	Business done during week ended April 27th, 1898. Highest.	Lowest
30,000	British Electric Traction	10	...	...	...	15½— 16½	15½— 16½	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all paid)	10	...	...	...	.....	7½— 8½	...	...
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	2	2½%	*nil*	*nil*	1⅝— 1⅞	1½— 1⅝	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2⅛— 2¼	2⅛— 2⅜	2 5/16	...
125,000/	Do. do. 4½ % Perp. Deb. Stock.	Stock	...	...	...	110 —114	110 —114	114	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10 — 10⅛	10⅜	10⅛
129,179	Do. do. do. £6 paid	10	...	...	...	6¼— 6⅜	6⅛— 6⅜	...	...
59,254	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1⅛— 2	1⅛— 2	...	...
67,680	Do. do. Def. do. £5 pd. ...	...	...	...	...	4⅝— 4⅞	4⅛— 4⅜	4¾	...
630,000/	City and South London Railway	Stock	1 1/16%	1 1/16%	1⅛%	68 — 70	67 — 69	68¼	68
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	...	...	2 — 2⅛	2 — 2⅛	...	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5⅛%	...	2¼— 2⅜	2¼— 2⅜	2 1/16	2⅜
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5⅛%	...	4 — 5	4 — 5	4¼	...
194,023	Do. do. do. 4% Deb. stock Red. ...	100	...	...	...	103 —105	103 —105	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	5 %	6 %	...	2⅝— 2⅞	2⅝— 2⅞	2⅞	2⅝
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343	2	7 %	7 %	...	3⅛— 3⅜	3⅛— 3⅜	3⅛	...
111,100	Do. do. 4% Perpetual 1st Mort. Deb. Stock	Stock	...	...	...	106 —108	106 —108	107	...
91,196	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,893	2	...	...	...	1/32— 1/16	1/32— 1/16	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	...	...	...	1/32— 1/16	1/32— 1/16	...	...
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	8 %	10 %	12 %	21½— 22½	21½— 22½	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	104½	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	2½%	3½%	10 11/16— 10 13/16	10 11/16— 10 13/16	...	...
12,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15¾— 16¼	15¾— 16¼	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	15 %	15 %	35 — 38	35 — 38	36	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
540,000/	Waterloo and City Railway, Ord. Stock	100	...	...	...	135 —138	133 —136	136	134

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary £5 (fully paid) 10⅝.

House-to-House Company, 4½% Debentures of £100, 108—110.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 16—17; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10 %.

* From Birmingham Share List.

London Electric Supply Corporation, £5 Ordinary, 3½—4.

* T. Parker, Ltd., £10 (fully paid), 15½.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

Bank rate of discount 4 per cent. (April 7th, 1898).

MARGINS FOR ECONOMY.

We referred some time ago to the very large margins for economy which existed everywhere in this country, and which, if taken in hand, would go a long way to the routing of foreign competition, which has become formidable from not having these wasteful margins. We might instance an example which came recently under our notice, and which serves to illustrate our meaning. In passing through a boiler shop we noted a locomotive type boiler in course of being stayed. Two men were at work upon it. They were tapping the holes for the stud stays, using the customary long tap which passes through both plates, and which in our young days was laboriously turned through by hand labour.

When flexible shafts were introduced they formed a very valuable and rapid auxiliary, and put the taps through the plates in very much less time than was possible by hand. On the boiler which came under our notice there were two men at work. One of these men was armed with a flexible shaft, but the other man was putting his tap through at about treble the speed effected by the flexible shaft. He was using a little compressed air three-cylinder engine contained in a small cylindrical box, and coupled up by a flexible India-rubber tube to an air compresser. At the rate he was doing the work he would save, as compared with his fellow workman, about, shall we say, only 10s. a week. It would be more. This would soon pay for a new apparatus to replace the old flexible shaft, which, in its turn, had replaced the hand work. But it occurred to us that if the shaft were changed for a small motor, the new tool would put to shame the rapid air tool we so much admired, and very soon the air tool also would be displaced by an electrical tapper.

We would not quarrel with the use of compressed air in the workshop. For some purposes it is better than electricity. For example, we think air is better than electricity for operating small direct lift cranes, such as are employed to lift work from the floor to a lathe. These small cranes are direct acting and easily controlled; they might as well be water-worked, except that water has the freezing objection to contend with, and there is more or less risk of leakage. They may not be very efficient, but they are cheaper than a small electric crane would be. But for portable drills, reamers, tappers, &c., electricity is certainly more easily applied, and more efficient than compressed air. For this class of work, involving the reaming or tapping of hundreds of holes, the element of speed is important and in electricity we find an agent which is peculiarly suited to small high-speed tools.

Great as is the economy to be derived from electric driving in large workshops, it is as nothing compared with the saving to be secured by its use in small shops. We mean such little shops as are run with a small vertical boiler and a little wasteful steam engine. In a recent investigation by the writer of the conditions of one of these small workshops, it transpired that the only regular work to be done every day was the driving of a fan using about a third of a horse-power during not more than half the day. To drive this fan required the engine and boiler, and if the boiler fire did not keep alight all night, it would happen that work could not start in the morning for an hour after starting time. This delay alone must often have cost from £2 to £4 per week. Then the boiler required either the constant attention of one man, or the partial attention of a striker, which meant delay. Fuel cost about £1. The total expense for power was thus quite £4 to £6 one week with another, or more than sufficient in a year to have applied an electric motor to each machine, and paid for current for a few years also.

But conservatism and ignorance stood in the way of the new motive power, and, so far, has prevented its adoption. Few realise how very partial is the running of machine tools. Often they do not work, even when busy, half the time. There is stoppage for tool grinding, resetting, calipering work, changing work, &c. Yet all this waste time the shafting is going round, and fuel is consumed. Few people are aware of the extent of small industries in large towns, and especially in London, nor of the enormous waste of power involved in turning round the shafting.

One such shop lately seen by us was driven by a gas engine placed quite 100 feet from the work. To do work of only a quarter horse-power pretty well loaded up a 6-horse gas engine. In fact, loaded or unloaded, the engine seemed to record about the same number of explosions. The gas engine might have driven a dynamo, and all the shafting might have been abolished. It is all very well to say that if shafting is kept in order it will absorb much less power than is usually the case. But in practice it is the small shop which is worst off for shafting, because there is not the staff to look after it, and in every respect the small shop is at a very great disadvantage, both in respect of the fuel consumption for the energy output of the engine and in respect of the mechanical efficiency of the organs of transmission. The dead load bears so large a ratio to the live load, and moreover, the dead load is run 10 hours a day, where the live load is run from two to six hours only. Gas engines pay in small shops as compared with steam, but

gas engines do not enable us to dispense with shafts and belts, and they also must run all day. It is very much in the time not worked that such large economies are possible with electricity.

Even where steam is employed the attempts to economise it are very half-hearted. We have seen live steam used for heating where exhaust steam would have done as well. We have seen a drying stove heated by the steam pipes to the engine, which were left bare on purpose to help the stove. The owners would not listen to any explanation that the resulting wet steam was very prejudicial to the economy of the engine, and there was no water separator. This sort of economy—for the owners believed that in thus using the engine steam pipes they were saving a set of pipes, and also so much non-conducting covering is really very common. Moreover, these same pipes had nine bends where two only were necessary. Had this pipe been made direct and covered the lengths of pipe saved would have been sufficient to have made up the stove heat, for the steam pipes were not wholly on the stove. Some of them were out in the open air and bare in places to the rain.

And people talk of hard times. All the examples cited have come under the writer's direct attention; they are but samples of thousands more or less parallel instances of waste, and we are bound to say that in many similar cases pressure to remedy has come from below—from the man at a few shillings a week, and has been blocked by the man above, whose refusal was usually that he did not see why such or such an action would save fuel. Electrical driving, even when it comes from outside generated power, appeals to such men when they happen to get it because they are keen to reduce a metered charge. These same men will go on paying for coal in excess because they have not the knowledge to teach them how to estimate where the losses come in. We have known them pay for expert advice, and refuse to follow it because they could not understand "*why it was so.*"

COMMERCIAL FORMS OF ELECTRICAL RESISTANCES FOR LIGHTING AND POWER PURPOSES.*

By Ll. B. ATKINSON.

The functions of a resistance being primarily to regulate or determine the amount of the current, which it does by its resistance, its second function is to dissipate the heat produced by the electric power expended on the resistance. This becomes a matter of cooling surface, and leads to a wide range of possible designs.

Speaking generally, then, in considering electrical resistances, the points to be considered are the (1) material of which the electrical resisting circuit is composed, (2) the nature of the support for such circuits, and (3) the material for insulating the circuit from the support, and, in addition, the nature of the switching mechanism for varying the amount of resistance in circuit.

(1) Material of which the Electrical Resistance Circuit is Composed.

Since all conductors offer resistance to the passage of the electric current, any conductor may be used as a resistance. The following table shows the resistance of 1 centimetre in length of various metals and alloys, carbon, and liquids, the cross-sectional area of the specimen being 1 square centimetre and the temperature 0° C.

Table of Specific Resistances.

Table I.

	Resistance per cubic centimetre.	Percentage variation per degree Centigrade.
Silver	1·504 microhms	·377
Copper	1·598 „	·388
Iron	9·716 „	·453
"German silver" ...	20·93 „	·03
Platinoid	51·0 „	...
"Manganin" ...	52·0 „	practically *nil*
"Eureka"	60·0 „	„
"Rheostene" ...	100·0 „	„
Carbon	4,200-40,000 „	—·2
"Relugite"	3·2 to 3,200 ohms	—·2
Solution of soda (10 per cent. solution)	11·5 ohms	...
Solution of zinc sulphate (density 1·405)	28·3 „	...
H_2SO_4 (density 1·10)	1·37 „	—1·7

This table is only to be used as a guide, since, except with pure silver and copper, as all the other materials are of somewhat undefined composition, and the resistance of alloys and carbon varies greatly with their chemical and physical condition. It will be observed that several of the materials used are special alloys, for the most part of nickel and manganese, which, in addition to having a very high resistance, have a very small temperature coefficient, which is important, as resistances are often worked to a temperature of 200° C., causing a very considerable variation of resistance.

An interesting example of this is in the use of iron wire when it is approaching a red heat, in which case it will be found that the resistance rises so rapidly, that a very large increase of E.M.F. will only cause a very small increase in the current, because as the E.M.F. is raised, causing a small increase of current, this raises the temperature, so that the resistance rises almost as fast as the E.M.F.

The writer some years ago used this property for arc lamp resistances, when even if the lamp was cut out, the permanent rise in current was quite small.

The metals, solids, and liquids shown in the table are those which are most frequently used for making resistances, and with regard to these, the usual form of the metals and alloys is in the shape of wire or strip, the former generally wound into coils.

Carbon may be used either in rods, in which case the ends should be electro-coppered, and the connections clamped and soldered to the copper, or the carbon may be used in the form of flat plates piled on one another.

The material, "Relugite," shown in the list, is a new material, now being put on the market by the Electric Insulation Syndicate, of Cardiff, and having an incombustible base, such as asbestos, in which is deposited conducting carbon, and the specific resistance of which can be made as required within the limits given, and this material also may be used either in strips, the current passing from end to end, or in plates or layers, through which the current passes.

Liquids are used generally where high resistances are required, and are on the whole an unsatisfactory form of resistance, as the solutions creep and cause loss of insulation on the circuits to which they are attached, whilst the liquids also leak or evaporate, so that they have to be made good, and the composition and resistance is constantly varying.

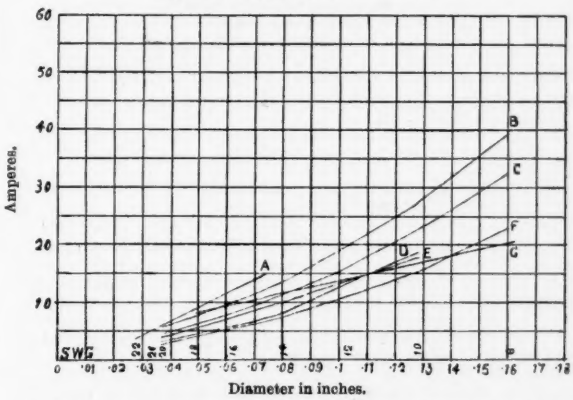
Carrying Capacity of Resistance Materials.

It is important to determine what is the carrying capacity of the wires, strips or plates, of which a resistance is composed; this being defined in relation to some particular allowable rise of temperature.

The rise of temperature to be allowed is probably the point on which the greatest difference of opinion seems to exist among manufacturers.

It is somewhat curious that the fire insurance offices who define to a nicety the insulation of the circuit and other quantities, are exceedingly vague on what is probably one of the chief fire risks that are run, most of the offices satisfying themselves by merely stating that the resistance should be constructed of, and mounted upon incombustible material, and that no combustible material should be within a foot of the resistance.

Diagram of carrying capacity of metal wires.



A, Iron wire coils on ¼-inch bar, 230° C.; B, Rheostene 150° C.; C, Rheostene 100° C.; D, Iron 50° C.; E, Silver 50° C.; F, Rheostene 50° C.; G, Tinned iron maximum safe current.

Since most organic matters and fabrics char at a temperature of 200° C., the writer thinks that that limit at all events should never be passed, and probably the rule defining that the maximum temperature of the hottest part at the maximum working load should not exceed 150° C. would be a safe rule.

The principal methods of dissipating heat from resistance are by radiation, air currents, and in certain cases by circulating liquids, such as oil or water.

The amount of heat radiated at the temperatures discussed is not large, and the use of liquids for cooling is not common, so that practically speaking cooling by air or currents is the usual method.

It is obvious, therefore, that the designs should be such as to allow a free circulation of air through those parts where the heat is being produced.

Wire Resistances.

For this reason where wires are used, it is advantageous that the diameter of the wire should be small, so as to give a maximum surface for a given cross-sectional area, and to carry the requisite current a sufficient number of wires should be placed in parallel.

Again, where wires are wound into coils, these coils should be open,

* Abstract of paper read before Northern Society of Electrical Engineers.

and there should be a space between successive turns of the coils of 2 or 3 diameters to allow an effectual passage of air.

In the case of long coils placed vertically, the upper parts of the coil become far the hottest, as the air heated by the lower coils is the only cooling medium.

It is almost impossible to give any general rule as to the carrying capacity of wires in coils.

The Diagram shows the relation between the diameter of the wire and the carrying capacity of wires stretched out straight in the air, and for certain temperatures.

If the wires are in coils drawn out so that the space between the wires is about 2 diameters, the current the wires will carry for the same temperature will be about one-third of that given by the diagram.

One of the most effective forms in which wire can be used is in the form of wire gauze, and the best class of gauze is that in which the longitudinal wires carry the current, the wires all being in parallel connection, whilst the cross threads carry away the heat, and in this case the load to be carried by a given wire is double that given in the table.

A great difficulty occurring with wire resistances, particularly where alloys, such as German silver, are used, is that the wires become brittle or rotten, and break, causing short circuits, and danger of fire.

In the case of resistances enclosed in boxes so that only the outside surface will dissipate the heat, the carrying capacity of the wires is much less than that given in the table, and the ultimate carrying capacity of the resistance will depend on the surface of the casing exposed to the air, and for a temperature of 150° C., the total external surface should be about 10″ per watt to be dissipated.

The surface for this purpose may be increased, if of metal, by casting ribs or fins upon the casing, so as to increase the surface.

Some resistances are only required for a short time at intervals, such, for instance, as resistances for starting motors, and here the element most to be considered is not the surface on which depends the power of steadily dissipating heat, but the total specific heat of the parts on which depends the rise of temperature with the given load in the time for which it is to be used, and in this case materials having a high specific resistance with large bulk may be used to advantage, or if fine wires are used, they may be imbedded in materials such as enamel or sand or asbestos, which will absorb, by conduction, the heat from the wire itself.

Carbon Resistances.

A common form of carbon resistance consists in the use of ordinary lighting pencils, with the ends coppered and connected up by clamps.

These resistances for testing purposes can be run at a very high temperature, but they dissipate heat badly, they are very liable to be broken, and are not often used for resistances which may have to be transported.

Carbon resistances made up of plates placed in a frame are often used, and they have the advantage that the resistance may be varied by screwing them up more or less tight by a clamping screw.

In this case a very large part of the resistance is due to the resistance of the surface of the contact between the layers, and due, also, to the fact that the current travels in the plane of each layer from the points of contact at the surface, of one set of plates to those of the next set; these, in most instances, not coming opposite to one another on the plates.

In other words, except when the plates are screwed up quite tight, the current is travelling by a zig-zag course through the pile of plates, and it is principally this which enables the resistance to be varied.

The material previously mentioned, viz., "Relugite," is used in the same way, and with the same results, but it has a great advantage over the carbon resistances, in that the material being flexible and elastic, a much wider range of the screw is obtained, so that the resistance can be varied more gradually, whilst the tendency with solid carbon resistances for the plates to actually break contact and so set up an arc is got over.

The chief difficulty with carbon resistances is that they present a very small cooling surface.

This difficulty has been obviated in the case of "Relugite" resistances by interposing metal plates between the plates of material, which metal plates are larger than the plates of the material, and thus serve to conduct the heat from between the plates, and to present a large surface for the air to pass through to cool them.

Liquid Resistances.

The commonest form of liquid resistance is a wooden tub filled with water in which is sulphuric acid, common salt, washing soda, or other metallic salt, to render it more or less conductive, and in which are immersed plates leading in the current.

Such resistances cannot, of course, rise above the temperature of boiling water, and they absorb a large amount of heat due to the large latent heat of steam.

Such an arrangement is, of course, a very rough one, and only used for temporary purposes.

For permanent installations iron or earthenware jars or pots are used, containing solutions, and having electros of various forms which can be moved in relation to one another.

(2) Materials for Supporting Resisting Wires or Materials.

In the early days of the use of electric power, resistance wires or coils were usually strung in wooden frames, and the writer believes he was the first to introduce into the market standard patterns of resistances, in which the supports were wholly composed of incombustible material, that is to say—iron frames carrying slate or porcelain insulating parts, to which were attached the resisting wires.

These resistances may be, and usually are, provided with a switch having a number of contacts, which enables, more or less, the resisting wire to be included in the circuit.

A class of support previously mentioned is the use of enamel on a base of iron. In this case the iron is first enamelled, to give it an insulating coating; the wires, which are very fine, are then placed on the enamel, and covered with thick coating of enamel, which is then fused, so that the wires are firmly imbedded in it.

The resistances known as the Carpenter resistances, and the resistances in most heating and cooking apparatus, are arranged in this manner. In this case the enamel carries the heat from the wire to the iron supports, which then distributes it, and forms the cooling surface.

In the case of the "Relugite" resistance material, this is carried in iron frames, generally on pillars or bolts passing through it, the insulation being enamel, and in certain cases mica or asbestos sheets are used where flat surfaces are to be insulated.

In a form of liquid resistance which the writer has used, the current enters at the bottom of one tube and leaves at the bottom of the next tube, a wire fork or bridge being raised or lowered in the tubes.

A curious phenomenon occurs with such an arrangement, the complete explanation of which the writer is unable to give, viz.: That using lead plates at the bottom of the tubes and a copper or iron bridging piece, the resistance and heating effect is not equally divided between the tubes, but is largely concentrated in one of them.

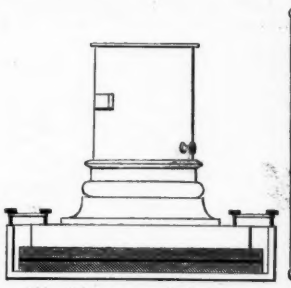
(To be continued.)

TRIAL OF THE SULLIVAN UNIVERSAL GALVANOMETER ON A TORPEDO BOAT.

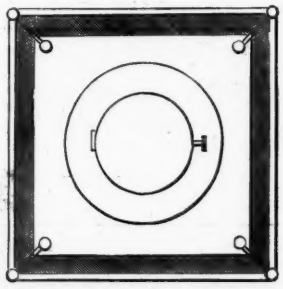
The Sullivan Universal Galvanometer has recently been tried in the English Channel on an Admiralty torpedo boat steaming at various rates of speed. The object of the trials was to determine the effect on the working of the instrument of the excessive vibration experienced on those vessels. Throughout the observations the galvanometer was mounted in a cabin aft almost immediately over the propeller, with the instrument facing towards the bow, and in the first instance was screwed to the cabin table in the usual way without a cushion of India-rubber or other vibration absorbing material interposed between instrument and table. Thus the vibration of the boat was communicated direct from table to galvanometer. The distance between mirror and scale was 42 inches. The following is a record of the behaviour of the galvanometer under these conditions:—

The boat was found to be most vibratory at 300 to 350 revolutions of the engines per minute (about two-thirds full speed). The observations noted below were all made at that speed.

So severe was the vibration then experienced that a glass of water placed in a receptacle on the table was in a few minutes more than half emptied. Nevertheless, the instrument behaved very well.



Side of tray removed showing the hair felt pad.



Showing galvanometer in tray and rubber stays at four corners.

Only an occasional movement of 30 to 50 scale divisions was noticeable. In every case this disturbance was of the nature of a sharp throw, the spot of light immediately returning to zero without oscillating or passing that point. At all other times there was no perceptible unsteadiness.

The galvanometer was then mounted as follows, and a further series of observations made:—A thin wooden tray was screwed down to the table, and inside were laid two thicknesses of hair felt, each of them ·8 inch thick, together making a pad or bed about 1·5 inch thick when not compressed and 1 inch thick when the galvanometer was on it. The internal dimensions of the tray were 12 inches by 12 inches by 3 inches deep, thickness of sides ¼ inch, and bottom ½ inch. The flat portion of the wooden base of the galvanometer stood just below the top edge of the tray. At each corner of the galvanometer base (and in its screw holes) and at each corner of the tray was a screw, an India-rubber band connecting each pair of screws, so that at each corner there was an elastic stay sufficiently strong to keep the galvanometer in position when the boat rolled and pitched heavily, and yet the India-rubber bands did not transmit vibration from the tray to the instrument.

With this arrangement and the propeller doing its worst the galvanometer disturbance was reduced to an occasional throw of five divisions only, increasing at odd intervals to about 20 divisions.

Apparently this occasional and slight increase of unsteadiness coincided with sudden changes of the helm which combined with the ceaseless vibration from the propeller produced a severe jarring effect. At other times the spot again was absolutely steady, and in all cases the coil immediately resumed the zero position without oscillation.

Hitherto the galvanometer had been on open circuit. It was now short-circuited. The result was to still further reduce the maximum and occasional throws which had been noticeable upon changes of the helm from 20 to 10 divisions.

Some measurements then were made over the full range of the scale with perfect ease, the coil when deflected being as steady as when in the zero or resting position either on open or closed circuit.

During one part of the trials a short and choppy sea was encountered causing the boat to be very "lively" with sudden irregular movements, but, notwithstanding this effect and the excessive vibration of the propeller, the galvanometer, as before, preserved its equilibrium. It should be mentioned that the delicately suspended coil was in perfect balance.

An ordinary and less sensitive iron-clad marine galvanometer set up alongside the Sullivan, and in the same way, vibrated to such an extent that the spot of light continually left the scale on either side and was often invisible, observations of any kind with it being out of the question.

In view of the great galvanometer disturbance which mechanical vibration, apart from rolling and pitching, so frequently sets up on board ship, preventing any reliable observations being made, these trials may be considered interesting as showing the steadiness of the new galvanometer under the severest test to which any such instrument could possibly be subjected, and Mr. Sullivan is to be heartily congratulated on having achieved such perfect control over one of the most delicate of electrical measuring apparatus.

The Sullivan Universal Galvanometer, mounted on a cradle board to imitate the rolling and pitching of a vessel, may be seen in operation at the offices of Mr. H. W. Sullivan, 19, Great Winchester Street, E.C., the inventor and sole maker.

SUBMARINE CABLES IN TIME OF WAR.*

Trade and Telegraphs.

America, it is stated, has claimed the right to cut cables connecting Cuba with the islands of Jamaica and Bermuda, and Spain has objected on the ground that the Telegraphic Convention protects these lines. Already the electric communications between Key West and Havana have been seized by the Americans. The whole question of transmission of cablegrams through neutral territory and along wires owned by neutral shareholders bristles with delicate questions and interesting points. In the course of inquiry into the subject, which not only concerns the belligerent Powers, but intimately affects our own trading and commercial relations with the Western hemisphere, a representative interviewed a gentleman whose position and experience entitle him to express an authoritative opinion upon the manner in which hostilities may interfere with the working of the submarine channels of communication between the Old World and the New.

"The Americans," he said, "I have no doubt, were within their rights in taking control of the cables between Key West and Havana. They belong to an American company, and the Government of any country granting a license to land cables invariably reserves to itself the right to enter into possession and to work them, accounting to the shareholders for the receipts meanwhile. The proprietary company of the Key West cables is the International Ocean Telegraphic, which is leased to the Western Union, the great company of America. But when you speak of the Americans cutting the cables which connect Cuba with the British island of Jamaica a different question is raised, as the line from Batahano to Cienfuegos, and the double line thence to Santiago de Cuba, on the southern coast of the island, are both British property, for they are owned by the Cuba Submarine Company, which has its offices in London. It is an English concern. From Santiago de Cuba to Holland Bay, in Jamaica, another British company—the West India and Panama—owns the cables."

"Is there any provision in the Convention to protect this property?"

"Cables are not neutral in time of war. The Submarine Telegraph Act of 1885 scheduled an international Convention, which authorised and made it legal. This Convention between the civilised States of the world was for the protection of submarine cables against wilful damage, &c., but there was this express provision in it: 'It is understood that the stipulations of the present Convention do not in any way restrict the action of belligerents.' I imagine, therefore, that there is nothing to prevent any belligerent cutting cables, but if he wilfully does so, in the case of a cable belonging to a neutral country, that country, or the company owning the line, would have a claim against the offending Power for the destruction of property. But still, the countries of the world could not complain diplomatically of such damage, as they would be justified in doing supposing that a belligerent fired upon the Geneva Cross. Let us take it that we were at war with Russia. Russia would be at liberty to cut any of our cables without raising an international outcry, but if Russia, at war with us, were to cut the cables of an American company, my impression is that the aggrieved party would have a claim against the Russian Government for damages. But it is a legal question."

"If the United States and Spain both recognise the principle, as they now do, that the neutral flag covers enemy's goods, except contraband of war, and that neutral merchandise, except contraband of war, is not seizable under the enemy's flag, why should not the same protection be afforded to cables?"

"Well, it may be argued that a cable is an effective engine of destruction, ordering troops and fleets to move, and so forth, as any other appliance used in war, which Spain has declared contraband."

"How do the two belligerents stand in regard to cables?"

"Should the United States cut cables in the West Indies, Spain may retort by grappling up cables, say, three miles off the Irish coasts—*i.e.*, outside our territorial limit. The Western Union Company have two cables across the Atlantic, and the Commercial have three, from Waterville in Ireland, to Canso in Nova Scotia. I should say that Spain could break these lines without breach of international agreement. It would be equivalent to a gun fired upon American property."

"But supposing Spain should not only grapple the American-owned cables—those of the Western Union and Commercial—but also cut the lines belonging to the English or French companies, what would happen?"

"I should think that such wilful damage to neutral property would be resented by the proprietary companies, backed up by the British Government."

"How can Spain communicate with Havana and Puerto Rico?"

"She can do so by using lines that run through British territory throughout; for, as far as I know, there is no intimation of telegraphic interruption with Puerto Rico. The route for a Spanish message would, therefore, be by one of the English companies to Halifax, Nova Scotia, and thence to Bermuda. The British have now a cable from the Bermudas to Jamaica, calling at Turk's Island, and between Jamaica and Puerto Rico there are, as I have said, two cables. So that Spain could have communication with both of her colonial possessions in the West Indies without touching American territory."

"But she would be entirely dependent upon the good offices of England. Has she no alternative route?"

"She can cable direct from Cadiz to Teneriffe; but from Teneriffe to St. Louis (Senegal) the cable is French, and from St. Louis to Pernambuco, crossing the Equator diagonally, the cable is British. England is placed in rather a singular position. To reach the Windward Islands we must enter Spanish territory at Puerto Rico. I can conceive it would be a wise measure to divert one of the cables from Jamaica, at present landing at Ponce, in Puerto Rico, to the Danish island of Santa Cruz direct, and thence to Trinidad and Demerara; and that plan, I should say, would be adopted. It would still leave Puerto Rico with one cable, landing at San Juan, from Jamaica. The French can, on the other hand, reach their coaling station at Martinique without touching Spanish territory. They have lines which go from Brest to Cape Cod, near to Boston, and they have recently laid a cable from New York to Hayti, which lies midway between Puerto Rico and Cuba, and thence to Martinique and to Cayenne. The French have also a cable from Santiago de Cuba to Hayti."

"Is it not possible to reach Jamaica and Cuba by way of South America?"

"Yes, by a roundabout route, traversing the Continent. Our Admiralty would probably direct the movement of ships in the Pacific by sending messages through lines owned by Englishmen and worked by Englishmen, first to Lisbon, and thence to Pernambuco, in Brazil, the cable being the property of the Brazilian Submarine—a British company—thence to Monte Video (Western and Brazilian Company, also British), then to Buenos Ayres (nominally Argentine, but actually British), thence to Mendoza, and so on to Valparaiso (Chili), and along the West Coast of South America to Chorillas, in Peru, hugging the land, whilst a competitive American Company takes a seaward curve to the same place. From Chorillas there are two lines—one to St. Helena, and the other to Payta, and one of them going on to Buenaventura, and then to Panama, across the isthmus of which, at Colon, a cable, which is British, connects with Jamaica, and thus completes the circuit. But you will notice that the Spaniards would be reluctant to use this route, as the links from Chorillas to St. Helena and Payta are owned by Americans. Similarly, though the map shows a possible communication *vid* the North-East Coast of South America from Pernambuco to Cayenne, the section between Para and Cayenne is invariably broken, so no telegraphic communication with the West Indies by that route is possible."

* *Daily Telegraph.*

SUGGESTIONS FOR IMPROVEMENTS IN POWER PLANTS.

The recent attention drawn to the wastefulness of the auxiliary engines of certain ships of the American Navy, and also of our own ships, notably the *Diadem*, has its counterpart in similar attention to the wasteful items of stationary plant. The subject is discussed by Mr. Bennett in *Cassier's Magazine*, the author's conclusions pointing to the use of electric motors in place of small engines and direct acting pumps. The main engines are always fairly efficient and, less the small loss of transmission, this same efficiency ought to be obtained in auxiliary plant also, whereas auxiliary plant is almost invariably very wasteful. As a railway or a light plant must always have one unit at work, or there will be a storage battery to draw upon, there need be no fear of the auxiliaries being too dependent or liable to interruption. Where the main engines are of condensing type the steam of auxiliary engines has been very much used for feed-water heating, and it is this apparent utilisation of the exhaust which has strengthened the hold of the simple small steam driven apparatus by a false assumption of economy. As a matter of fact, if flue feed heaters were applied to use the waste gas temperature there would be no field for using the exhaust of wasteful small

steam auxiliaries, and their place would be seen to be better filled by electrical motors. We need not follow our author into his recommendations of the flue feed heater or economiser, for though comparatively new to America it is old in England, at least in the north where fuel is cheap, though much less common in the south, where its economy would be so very much more marked.

The economiser is as necessary a step in steam production as is the second cylinder of the compound engine in steam using. It represents the principle of stage heating or counter currents, and in large plants may well be divided into two or more divisions in series so as to leave to the boiler proper little else to do than to give the latent heat necessary to turn hot water into steam. By this means alone can the waste gases be reduced to a temperature sufficiently low to fully justify a mechanical draught. If the waste gases are sent away very hot they may just as well assist to produce draught by a chimney, and it is not of much use adopting a power driven fan unless at the same time the waste gases are correspondingly reduced which can only be done by stage heating of the water, which is finally boiled off.

Moreover, where electricity is available there is no great need of a wasteful steam engine to drive the draught fan. Economisers are somewhat of a check upon a good draught, and are desirably associated with a fan which will revolve for less heat expenditure than a chimney will perform the duty, but as said above, if the chimney is to be abolished there must be a properly low temperature of the escaping gases.

THE SOCIÉTÉ INTERNATIONALE DES ELECTRICIENS.

Sitting of April 6th, 1898.

The annual general meeting took place on April 6th, with Dr. D'Arsonval in the chair. The general secretary was absent through illness, his place being filled by M. J. Laffargue, secretary. After the report had been read, the names of some candidates for admission were presented, and also some books. The voting list was then closed and tellers were appointed.

M. Armengaud read the report of the Committee of Accounts, which was received with approval.

M J. Laffargue then read a paper on "The Distribution of Electrical Energy in Germany."

He mentioned that last January he had the pleasure of accompanying on some professional business in Germany, M. Charles Bos, municipal councillor of Paris, and reporter on various electrical questions. He had occasion to visit a large number of distributions of electrical energy, and he wished to bring before the notice of the society some of his observations, confining himself, however, to technical matters.

Installations in Germany are on a large scale and very numerous, both for distribution properly so-called and for traction.

Sometimes these installations are combined, and a single central station effects both distributions. We have already given the statistics of the central stations of Germany. To these must be added since September 1st, 1897, 56 towns provided with 957 kilometres of electrical tramways, absorbing a power of 21,465 kilowatts; part of this power is furnished by the central stations used for both distribution and traction, of which we have spoken above.

The distribution stations are large, spacious, well managed, and very clean. In most cases they are situated near railway stations or near rivers, and sidings are always arranged to bring the coal up to the station. The boiler rooms are high and well ventilated; the boilers have a clear space between them and are easily accessible. The engine rooms are large and are capable of being enlarged still further. One can walk about freely amongst the engines, and approach all the parts. The distribution boards can be seen well from all parts of the room and the regulation is easy. For street canalisation only armoured lead-covered cables are used in Germany, made either by Siemens & Halske, or by Felten & Guilleaume. Under the pavements they are generally laid directly in the earth; under the roads they are sometimes protected in iron tubes, or in iron cases made specially. The wires intended for traction are nearly always overhead, at least as far as distribution wires are concerned. At various places, in order to prevent the falling of the telephone wires, iron wires are stretched across which add still more to the unsightly appearance of the overhead wires at cross-roads.

The indoor installations of the consumers are very bad in Germany. Notwithstanding the very strict regulations that we read of in various journals, we meet with few good installations. We see wires laid right against the walls, and merely held in place by hooks. Installations on porcelain insulators are numerous. The fitting up is often defective, metal covers scarcely fixed at all being used. Installations used both for gas and electricity are very numerous, and the wires are laid over the gas appliances without any precautions being taken. Several engineers told us that this state of affairs was now going to be looked into and altered.

We then examined some of the installations in the principal distribution stations.

At Frankfort we found a municipal central station under State management for the last two years. It was installed and is still worked by the Brown and Boveri Company of Baden. The engine room contains four compound tandem horizontal steam engines of 750 H.P. at 70 revolutions a minute, each driving directly four alternators of 500 kilowatts at 3,000 volts; a fifth engine of 1,500 H.P. is in course of erection.

The distribution board is in the centre of the room placed at a certain height; in the basement are the appliances for condensation.

The mains are formed of Felten & Guilleaume concentric cables; the transformers are placed at certain centres of distribution. At the end of the season of 1897, the installation included 40,825 incandescence lamps, 624 arc lamps, and 133 motors of 1,063 H.P. The public lighting included 100 arc lamps of 10 amperes and 800 incandescence lamps. Amongst the various installations of motive power, we particularly admired that of the *Frankfort Gazette* where three motors of 30 H.P. drive printing presses, and where there are a series of smaller ones for passenger and luggage lifts.

The cost of supplying the electrical energy is ·15 franc the kilowatt-hour for lighting and ·15 franc for motive power. At Frankfort, experiments are now being made in traction by accumulators, and are being carried on by the Pollak Accumulator Company.

This company has extensive works where the manufacture is being developed considerably. Besides Messrs. Pollak's special commutators, which serve for the formation and the charging of the accumulators made at the works, there are rotary transformers and motors driving dynamos. Cables connected to a post placed not far from the works enable the charging to be effected with a constant difference of potential of the accumulators placed in cars under the seats. The car passes under movable contacts and the charging at once commences automatically. In four minutes the charging is concluded.

We also visited while at Frankfort the works of the old firm of Lahmeyer, and of Hartmann & Braun; we found everywhere extensive works with electric transmissions and driving gear, and also fresh buildings in course of construction for extending the installations.

At Cologne there has been a municipal electrical station since 1891, established under the best possible conditions, luxuriously even. The distribution is effected by alternating currents at 2,000 volts, with transformation at the consumers' houses to 72 or 110 volts. The engine room, which is elegantly fitted up, contains four Sulzer compound engines of 650 H.P. at 85 revolutions per minute, working directly four Helios alternators of 450 kilowatts, and exciters of 110 volts and 300 amperes. The alternators are coupled in parallel with auxiliary resistances. The distribution board is placed in the middle of the room against the wall at a certain height. The arrival and departure wires are placed for each machine on a special board. On the fore-part is a switchboard, which, by the aid of levers, enables the chains to be manipulated that work the interrupters, and the circuit-breakers of the high tension circuit and of the exciting circuit. The circuit-breaking interrupters, the starting point of the high tension feeders, and also the charging resistances, are, in fact, placed in a special closed room, situated below and behind the distribution board.

The mains are in the form of concentric armoured lead-covered cables, placed in wooden cases. The central station has undertaken the lighting of the streets in certain quarters, and the feeding of some motors; sub-stations for transformation into continuous currents for traction are going to be supplied.

At Hamburg, the new station in the Carolinens-Strasse supplies three sub-stations of accumulators placed within the town, and furnishes the tramways with the necessary electrical energy. This station has a large boiler room containing 16 boilers, each with 250 square metres of surface, and an engine room of 17 metres by 50, in which are installed six triple expansion vertical steam engines of 1,200 H.P. at 100 revolutions per minute. Two of these engines each work two Schuckert dynamos of 500 kilowatts at 300 volts, three each work three similar dynamos at 600 volts, and the sixth engine drives a dynamo of 1,000 kilowatts at 600 volts. The distribution board is very well arranged; on the wooden part are placed all the arrival wires of the engines, and on the sides are the departure wires of the circuits.

There is also at Berlin the Post-strasse station, situated within the town, and containing five compound vertical steam engines of 500 H.P. at 120 revolutions a minute. These engines work five Schuckert dynamos of 400 kilowatts at 250 volts, which effect a special distribution.

The first electric station was established at Berlin in 1885. The distribution is effected by three wires at 220 volts. There are now four large stations and one sub-station, all connected with one another and feeding the same system of distribution. The station of the Markgrafenstrasse contains six compound vertical steam engines of 300 H.P. at 82 revolutions per minute, working dynamos with internal poles and also three rotary transformers of 400 kilowatts. The primary of these transformers is fed by the triphased currents coming from the station of Schiffbauerdamm. The secondary circuit is formed by a dynamo of 250 volts. The station of Mauerstrasse contains two steam engines of 300 H.P. at 82 revolutions per minute, four engines of 1,000 H.P., and two engines of 1,500 H.P. Amongst the dynamos are two of 238 kilowatts, four of 364 kilowatts, and four new dynamos of 650 kilowatts. In the station of the Spandauerstrasse are three steam engines of 1,000 H.P. and four of 1,500 H.P., and also six dynamos of 364 kilowatts and eight of 650 kilowatts. The station of Schiffbauerdamm contains three engines of 1,000 H.P., two of 1,500 H.P. working respectively six dynamos of 364 kilowatts and two triphased alternators.

The sub-station of Königin Augusta Strasse is fitted with two batteries of 138 accumulators of a capacity of 12,000 ampere-hours.

There is now in course of installation at Oberspree a large station of 50,000 H.P. which is to effect the distribution of electrical energy in the suburbs of Berlin. Up to the present the electrical tramways in Berlin have been worked partly by overhead wires and partly by

underground cables, the energy being supplied by the station of Mauerstrasse, from Behrenstrasse to Treptow, and from Treptow to Dönhoffsplatz. Experiments in traction have also been made with accumulators on the line from Berlin to Charlottenburg. At Berlin we also visited the works of the Allgemeine Elektricitäts Gesellschaft, and at Charlottenburg, the workshops of the firm of Siemens and Halske. The central station of Leipzig is situated outside the town; it comprises a system of distribution by continuous currents which supplies consumers living near, and a transmission by triphased currents to a sub-station situated within the town. A rotary transformer works a continuous current dynamo of 350 kilowatts at 250 volts, and also three *survolteurs* for Tudor accumulators. The whole of this installation was provided by the Siemens & Halske Company. At Leipzig there are two different traction companies working different systems, one running 80 cars and the other 185.

The town of Munich has up to the present only undertaken public lighting and experiments in traction. The distribution is effected at 660 volts and feeds about 850 arc lamps. The station of Muffatwerk contains at present a turbine of 200 H.P., working by transmission two Schuckert machines of 66 kilowatts at 330 volts, and three similar machines of 26 kilowatts; this same transmission is also driven by a steam engine of 300 H P. Two other engines of 350 H.P. have also just been installed, and one of 700 H P., and one of 1,000 H.P. is now in course of installation. M. F. Uppenborn, engineer-in-chief to the municipality, explained to us the projects that will shortly be put into execution, and which include three central stations using triphased currents with sub-stations using continuous currents, the whole comprising a power of 21,000 H.P.

At Nuremberg, there is a municipal central station which possesses four alternators of 450 H.P. at 2,200 volts, and one of 1,000 H.P. In the town a special system of traction by trolley is used. But what is most worthy of notice is the large establishment of the Elektricitäts Aktien-Gesellschaft, where at every step we meet with electric transmissions, machinery, experimenting rooms, foundries, and erecting rooms. The company is erecting by the side of the *first* establishment a second, which will perhaps be still further developed.

At Strasburg, the central station supplies electrical energy for distribution, properly so-called, and for traction. The steam engines, five in number, are compound vertical engines supplied by the Société Alsacienne, two of 200 H.P. driving at the same time a triphased current alternator of 80 kilowatts, a continuous current dynamo of 125 kilowatts at 500 volts, and three engines of 300 H.P., each driving a triphased current alternator of 280 kilowatts. It will be interesting to give a few particulars as to the cost price and the selling price. Generally speaking, the cost of coal is from 12 to 18 francs the ton, and we reckon about 3 kilogrammes per kilowatt-hour produced.

At Frankfort the cost price of the kilowatt-hour is ·305 fr., including interest and sinking fund. At Cologne and at Düsseldorf the cost prices are respectively ·192 and ·126 fr., including interest and sinking fund. The selling prices vary from ·08 to ·1 fr. the hectowatt-hour for lighting, and from ·025 to ·035 fr. for motive power, with reductions amounting to 40 and 50 per cent. We will conclude by saying that in March, 1897, Germany possessed 1,025,785 incandescence lamps of 50 watts, 25,024 arc lamps of 10 amperes, and a power of 21,800 H.P. for engines installed. At Berlin, at the end of the season 1896-97, there were 196,076 incandescence lamps, 9,173 arc lamps, 357 apparatus of various kinds, and 2,056 motors of 7,475 H.P. It must be remembered that in 1888-89 there were 17 motors of 60 H.P., in 1892-93 about 232 motors of 785 H.P., and in 1895-96 about 347 motors of 4,813 H.P.

M. R. Picou asked M. Laffargue if the prices named include both *the expenses of the sinking fund and the expenses of administration;* he also said that it is not possible to establish any comparison as to cost price with distributions possessing only a concession of short duration in order to ensure the sinking fund.

M. Laffargue replied that these particulars are given; it is quite evident that no comparison is possible between concessions whose respective durations are 40 and 18 years.

The President then read out the results of the elections. The candidates elected were as follows:—

President (1899—1900), M. Violle; vice-presidents, Messrs. Clérac and Monnier; secretaries, Messrs. Abraham and Grosselin; treasurer, M. L. Violet; Members of the Committee: Messrs. Blondel, Blondin, Bouchard, Chammat, Desrosiers, Ebel, Gaiffe, Gauthier-Villars, Ch. Ed. Guillaume, Cl. Krebs, P. Laporte, A. Larnande, Margaine, Poincarré, Radiguet, De Romilly, G. Lautter, J. Voisedat; Members of the Committee of Accounts: Messrs. Armengaud, jun., A. Berthon and G. Masson.

Dr. D'Arsonval then thanked the Society for the honour that had been conferred upon him by electing him president, and he invited M. R. V. Picou to succeed him.

M. Picou asked permission to postpone until the next sitting the customary speech, and the meeting then broke up.

ELECTRICITY IN WARFARE.

The establishment of the Electrical Engineers Volunteers Corps in this country has led to steps being made in the same direction by the United States. A year or so ago when there seemed some likelihood of our being brought face to face with the army or navy of some other nation, the idea of the English electrical corps was born. Since then there has been much organisation work to be done, but though this is in an advanced state we should question whether the corps would be ready for the field within a few weeks if required. Now, however, that America is in a state of actual warfare with Spain, and requires, we suppose, all her forces to be ready within a very short space of time, there is a somewhat similar movement on foot in that country. Over seven years ago the attention of the U.S. was forcibly drawn to the advisability of forming such a corps, and if advantage had been then taken of the warning, the States would probably by this time have possessed a well-equipped body ready for all emergencies. There is no doubt that the Hispano-United States conflict will teach many lessons in warfare to both countries, though what the result of the affair may be it is unwise to attempt to conjecture. But in the matter of electrical engineer volunteers, the States may perhaps regret that steps were not taken earlier instead of waiting for us to set the example. However, at past the eleventh hour, Captain Eugene Griffin, U.S.A. retired, the first vice-president of the General Electric Company, has organised an auxiliary corps of electricians and electrical machinists, which will serve in the army or navy, or both. The engineer corps of the army has been short of electrical experts, whose services have been in great demand in the preparation and planning of submarine mines and torpedoes. Captain Griffin recognised this deficiency of skilled workers, and, with the permission of the Secretary of War, formed his plans, and has carried them out to success. He has, according to our New York namesake, obtained the names and the day and night addresses of a large number of skilled workmen in the employ of the General Electric, Westinghouse, and other electrical concerns in New York and the New England States. This information was sent direct to General John M. Wilson, U.S.A., chief of the engineer corps, who now has it on file. A number of these volunteers have already been at work in New York Harbour, Boston, and Philadelphia. Later news says that in less than a week Captain Griffin enrolled over 1,000 men.

Our contemporary, in a recent editorial, remarked that ultimate success in both land and sea practice depends very largely upon the electric current in one form or another. The preparations being made by electrical engineers and manufacturers are briefly mentioned.

In the first place the government has purchased thousands of miles of submarine and underground cable and other kinds of wire. These conductors are to be used for connecting and operating submarine mines and torpedoes, for establishing means of communication between the coast defence fortifications, and for feeders to supply current to the searchlights located at advantageous points along the coast. Nearly all the large wire manufacturing companies were at the beginning of April working their plants day and night, and the orders of many of their regular customers had to be side-tracked on the patriotic understanding that the government's needs at such a time must take precedence. One wire company was ordered to manufacture all the cable of a certain type it could turn out by a specified date some months in the future.

There was great activity in the manufacture of searchlights, large orders being received. In this connection, it is interesting to note that central stations located near the Long Island coast, such as the Edison Company in Brooklyn, have arranged to supply all the current required to operate searchlights on the fortifications in their vicinity. Electricians familiar with setting and connecting submarine mines were in great demand. The army engineer officer in charge of the fortifications in the vicinity of New Orleans has made a request for as many experts as can be spared. The General Electric Company furnished a party of 20 experts to be placed at the service of the government for torpedo work and connecting up searchlights. The Western Union and the Postal Telegraph companies have formed two corps of expert telegraphers composed of 50 men each, equipped with pocket kits of tools.

The telephone companies along the coast have also made arrangements to assist the government in every possible way.

The later technical journals to hand by this week's mail are, of course, well stocked with news regarding electrical work in connection with the war.

Mr. Frank J. Sprague, of the Sprague Electric Company, is organising an emergency corps of electricians and electrical engineers to work in conjunction with the State Naval Reserve.

The Westinghouse Electric Manufacturing Company is shipping large quantities of generators, motors, dynamos and wires to the Brooklyn Navy Yard, for use in the installation of electric power and lighting plants on board the merchantmen, old monitors and coasting steamers being equipped by the government.

President McKinley has issued an executive order establishing the ratings of chief electrician, electrician first class and electrician second class, to be taken from civil life for service in the Navy. They will be required to pass a physical and professional examination at the New York Navy Yard.

Prof. Elisha Gray has been describing in the *Times-Herald*, of Chicago, a very ingenious arrangement by which the telautograph could be adapted in coast and harbour defences for locating the exact position of an enemy's vessel. By means of suitable electrical connections the device could serve as a range finder.

The government is, of course, giving special attention to telegraphic communication along the coast, and to and in the West Indies. The *Western Electrician* says that it has arranged for the establishment in one day's time of its own telegraphic system for secret service along the entire Atlantic coast. The whole coast will be divided into districts. The government intends to build houses on the beach, where naval reserve officers will be stationed with telescopes to keep watch and report to headquarters in the city all ships sighted at sea. The system will have connection with the Western Union telegraph wires and the long-distance telephone. Three operators will be stationed in the main office in Savannah, which will be in full charge of the office and the signal corps. The Savannah office will be in direct communication with the Navy Department at Washington.

In New York, Boston, and other harbours, the work of connecting

the coast defences for electrical communication is proceeding with energy. As a result of representations made by Capt. James Allen, signal officer stationed at Governor's Island, to General A. W. Greely, chief signal officer, of the absolute necessity of the expenditure of more than $25,000 in the telephonic and telegraphic connections between the fortifications in New York harbour, New York will get $25,000 more to complete this work according to the original plans. Boston will get about $10,000, Philadelphia about $5,000, and Washington, Baltimore, Newport, and Portland, Me., will also get increased appropriations. The total increase for the Department of the East is $96,000. This increased appropriation will make it possible to do an especially important work. All coast fortifications are provided with range finders for the purpose of determining the distance from the fortification of an enemy's vessel. These, if they are to be used effectively, must be supplemented by telegraphic apparatus, to enable the man in the tower to telegraph to the gun pits the range of the approaching vessel. The majority of the range finders in the fortifications are now so equipped. Every one will be equipped within 30 days.

One serious problem is the possible interruption of cable service in the West Indies. An arrangement was recently made by which the United States and France will co-operate through their ministers at Denmark in the establishment of a public cable station on the Danish island of St. Thomas. The cable is owned by a French company, but its use has become of vital importance to the United States Government, owing to the possible base of naval operations in the Leeward Islands. Secretary Long was particularly desirous of having this cable arrangement effected. As a result of conferences a dispatch was sent to the United States minister at Copenhagen asking him to secure the consent of the Danish Government, and at the same time the French authorities arranged to have their minister at Copenhagen exert similar influences. With the Leeward Islands, of which St. Thomas is a centre, as the probable centre of any naval operations which may result from the present crisis, it is recognised as of vital importance to secure cable facilities not controlled by Spain. At present the cable line touching at Puerto Rico, and subject to Spanish control, is the only means of communicating with these islands. The French cable lands at St. Thomas, but the station is merely for testing purposes, and messages are not received or delivered. It is now proposed to have this station turned into a regular bureau, in which case the government could be brought into close cable communication with any naval rendezvous there.

It is stated that the Western Union and the Postal Telegraph Companies have begun to organise corps of skilled electricians, whose services are to be offered to the government. The Postal Telegraph Company has already organised three companies of 50 men each in New York and an equal number in Boston for this service. The particular work expected of the men is the laying of submarine cables and connecting them with submarine mines and torpedoes. Every man in each company has been provided with a kit of tools, which, under orders, he carries with him day and night. The men have been informed of the service expected of them, and they have been informed that they will draw their salaries from the company as well as their pay from the government.

Lynde Bradley, of Milwaukee, has devised plans for the use of the X ray on board of war vessels and on the field. Mr. Bradley says that while it would be a simple matter to bring the X ray into use on a warship, considerable difficulty would be attached to the introduction of the apparatus on the field. A small outfit would have to be mounted on wheels for field use. The apparatus would, however, be much lighter and more portable than may be imagined, and his field apparatus could be finished in a week. The great help that the X ray would be to surgeons lies in the quick method of locating a bullet or splinter in a man's body, a fracture of a bone or other serious injury.

It is said that the government has practically closed a contract with the General Electric Company for eight 400,000 (projected) candle-power searchlights with dynamos, to be set up in the fortifications in New York harbour. This order will be supplemented in a short time by one for several more to be placed elsewhere.

The largest searchlight that had a place on the top of the manufactures building at the World's Fair has been brought from Sandy Hook to Fort Monroe, Va. It will illuminate Hampton Roads from shore line to shore line.

HIGH RESISTANCE INSULATION.*

By REGINALD A. FESSENDEN.

In laboratory apparatus in many cases, for instance, with electrometers and resistance boxes, we need as high ohmic resistance as it is possible to get. Here, however, we are met by the fact that the two substances most commonly used, *i.e.*, hard rubber and glass, are among the poorest insulators known for this class of work.

Rubber is very objectionable from the fact that whilst it presents a nice bright appearance when new, it contains sulphur and is very easily oxidised, especially when exposed to light. A film of sulphuric acid is thus formed on the surface, and if the tongue be applied to a piece of rubber which has been in use for some time the taste of the acid is very strong. I have seen the top of a Wheatstone bridge, supposed to be capable of measuring accurately to one part in 5,000, in which the total length exposed to leakage, divided by the average distance between which leakage could take place and the average voltage was only ·008, with the top so acid that the tongue could hardly be allowed to touch it.

As a rule it is very hard to remedy this; rubbing the surface does no good as the acid extends in to some distance. Rubbing with cigar ashes is advocated by some, but I should fancy it would be almost impossible to remove the last traces of alkali. The method used by the writer is to steep the rubber in warm 10 per cent. caustic soda, then in warm distilled water, frequently renewed, then drying in the dark quickly and rubbing with pure paraffin, treated as described under paraffin, then polished while warm. This does good for a time, until the paraffin takes up dust.

For rods, a good way is to treat as above and coat half an inch thick with paraffin; then run over the rod with a wooden die and cut a thread in the paraffin. Run over the thread about once a month, and good results will be obtained.

With bridges, however, it is impossible to remove the top, and the only thing which can be done is to keep them covered up from light.

Rubber has also one other disadvantage, in that it does not show dirt, and where rubber comes in contact with copper it is apt to rot.

Glass is very bad because the alkali in it has a great affinity for moisture. The alkali is slightly soluble, and hence it is the custom with analytical chemists to boil all beakers used in exact work for several days before using, so as to get the soluble alkali and silica out of them. When possible this should be done with the glass of electrical apparatus. Another very serious trouble is that the angle of contact between water and glass is zero, so that when a drop of water is placed in the middle of a pane of clean glass it immediately spreads all over it in a thin film. This method is used by chemists to determine when a glass is clean. Nothing much can be done with glass but to keep it dry. Sulphuric acid is generally used, but it sometimes, if allowed to get dust in it, gives off vapours which condense on the sides of the apparatus. This, however, does not often happen.

Evidently we need some substance of high ohmic resistance, and one which water will not wet. Boys, who has earned the thanks of electricians for his happy discovery of an almost perfectly elastic fibre, has given us also, as he himself has pointed out, such an insulator in quartz. Dip a thread of glass in water and lay it between the knob of a charged electrometer and the ground, and the leaves close almost at once, the whole fibre being covered with a film of water. Treat a quartz fibre similarly and the water slides off it, or remains in little drops, each separate from its fellow, and the insulator is apparently as good as the air itself.

Quartz should, therefore, be used as much as possible in electrical instrument work. It can be melted in a powerful gas flame furnace, and though it can never be melted down free from small bubbles, these make no difference except in appearance. It is, however, possible to obtain glass which contains no alkali, and resembles quartz in that is not wet by water. Such a substance is Faraday's borate of lead glass, as he himself points out. This is, however, too brittle for most work, but by an admixture with silica a glass could no doubt be made which would be perfectly satisfactory. If some glass manufacturers would take up this question and furnish us such a material for electrical instruments, the greater part of the present annoyance met with in making delicate experiments would vanish. It would not leak, would show dirt, could be readily cleaned, and would be free from one of the great disadvantages of rubber, *i.e.*, a large co-efficient of expansion, which is always making trouble by bending terminals of resistance coils, thus changing their value and sometimes opening the circuit.

It is also probable that a fine grade of porcelain would be a great benefit to the electrical profession, if coated with a good non-alkaline glaze.

For insulating the coils of resistances it is doubtful if we

* Extract from a paper read before the American Institute of Electrical Engineers. From an incomplete advance proof.

have any good solid material. For paraffin cannot be used, as its expansion and contraction are so great that large pressures are put upon the wire and the resultant strains change the resistance. It might be easy enough to prevent the strain on the first solidification in a way similar to that devised by Rowland for cementing flat mirrors without buckling them, *i.e.*, by mixing a little glycerine with the beeswax; the glycerine not dissolving in the beeswax makes it act like a viscous fluid, *i.e.*, deform under the action of infinitesimal forces in time. The glycerine, however, finally works its way out like zinc in a resistance alloy (as first pointed out by Mr. Weston), and if a similar method were used with the coils, it would still be subjected to strains on change of temperature. Another objection which has been made in England is that paraffin absorbs moisture. It is possible that this is due to the dissimilar methods of producing American and English paraffin, as I have never had to complain of this, except, of course, when cold paraffin was placed in saturated moist air. The insulation resistance of paraffin seems, however, to be markedly increased by the treatment mentioned below. The great objection to paraffin is its tendency to collect dust. Shellac has been recommended, and since the coils are in the dark, the material will oxidise but slowly, and if care be taken to use pure alcohol for a solvent, and not denaturised spirit (which sometimes contains conducting impurities), has a very high resistance when dry. Some forms of Japan lac seem to remain flexible permanently, as, for instance, the sample *a* (composition unknown), which is 10 years old.

Oil is sometimes used for resistance coils, and this is without doubt the best method, since the great point in the use of resistance coils is to know their temperature. The writer's experience with manganin and constantin, as practical laboratory standards, has been unfortunate, and he has hence decided to use only standards of pure lead run into glass tubes, and kept in water. The reason is that, other things being equal, the most sensitive Wheatstone bridge is that which takes the greatest current without appreciable heating, and in the ordinary form of resistance coil, a very small current will heat the interior up to such a temperature, as to alter the value. Moreover, if the coil is of a material not affected by such changes of temperature, it (with our present alloys) will have a larger temperature coefficient, and as the temperature of the interior of the coil is not known, this introduces another uncertainty. With the oil mounting, however, this is all done away with, and pure oil has a very high resistance for low voltages.

For condensers and induction coils it is not only necessary to have materials of great ohmic resistance and of great dielectric strength; they must also be perfectly pure, and free from admixture. For the first two properties there is nothing so good as paraffin, when properly used, all compositions such as beeswax (cerotic acid), &c., being quite inferior in both respects. Paraffin, and what is practically the same thing, pure ozokerite, will stand, according to the tests of Mr. Chesney, which I had the pleasure of witnessing, at the rate of 500,000 volts per inch. This I have confirmed up to 600,000 volts alternating. Most substances, such, for instance, as glass, are at once cut out from consideration, from the fact that they have too much electrical absorption, and heat when subjected to a fluctuating voltage.

We must have an electrically homogenous dielectric, *i.e.*, one of the same specific inductive capacity all through. This

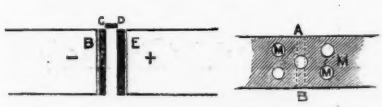


Fig. 5.

Fig. 6.

is for two reasons. First, because if we have a dielectric, A, between two charged conductors, the introduction of a dielectric of greater specific inductive capacity, even if of infinite dielectric strength and ohmic resistance, will cause A to break down. To take a numerical case—suppose we have two plates, 1 cm. apart, and attached to the terminals of a 10,000 volt A.C. dynamo (fig. 5). Suppose the dielectric, air, to support 50 per cent. more than this pressure. Introduce two plates of glass of $K = 8$, each $\frac{1}{4}$ cm. in thickness. Since the voltage divides itself up inversely to the capacitance, we will now have 8,889 volts between C and D. This being at the rate of 17,778 volts per cm., and as it only supports 15,000, we will get a spark between C and D at every reversal of the voltage, which will quickly heat the glass and make it conduct. The full potential of 10,000 will then be between C and D, and a regular arc will form. Thus we see that the introduction of a good insulator will, in all cases where an intermittent or alternating voltage is used, have the paradoxical effect of weakening the insulation, unless the whole space is filled up with the material. This weakening is not generally apparent at once, as the spark takes some time to eat its way back, and this explains why many induction coils only last for a few years of operation.

Another cause is that treated of by Poisson, Clausius and Maxwell.* This is, that layers of dielectrics of different

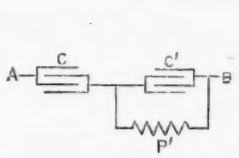


Fig. 7.

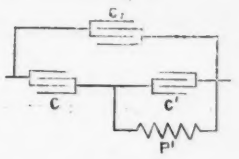


Fig. 8.

capacities and resistances show electrical absorption, and this theory has been proven experimentally by Muraoka, who showed that by taking two fluids, neither of which showed absorption, a layer of one on top of the other did do so. Maxwell treated the general case. It has, however, been treated in a more specialised way in *La Lumiere Elec.*, in 1891. In this paper are brought out the following points:—

1. A dielectric, as in fig. 6, containing conducting particles of water, for instance, may be considered as an arrangement of condensers and resistances in series and shunt with each other. Two cases, shown in figs. 7 and 8,

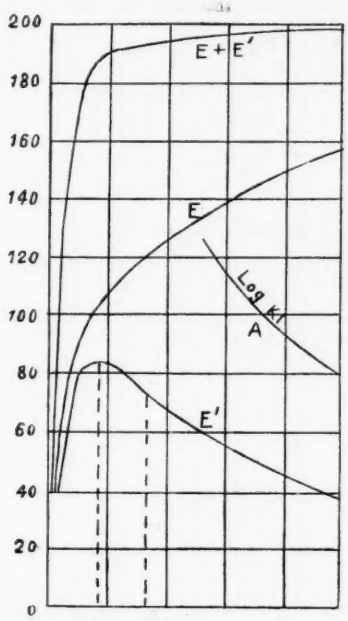


Fig. 9.

are worked out, and fig. 9 gives the curve of charge in the cases of fig. 7; E is the voltage on the condenser part, and E′ that on the condenser and resistance.

2. A condenser can show large residual charge, though its true ohmic resistance is infinite.

3. With dielectrics showing absorption, there will be found some discharge time at which the amount of discharge will be constant at all temperatures.

* "Elec. and Mag.," Vol. I, Chapter X.

4. Why in some tests insulation seems to be lower with higher voltages.

5. Why the presence of conducting particles increases apparent capacity.

6. That to get true ohmic resistance of most dielectrics, voltage must be kept on for a long time, even for days.

7. Why Siemens's method of taking the rate of loss of charge by electrometer does not give correct results.

8. That specific inductive capacity of such dielectrics can only be determined by rapidly alternating currents. This possibly explains an effect noticed by the writer many years ago, *i.e.*, that an A.C. static wattmeter immersed in water did not give anything like the torque it should have if the true value of K for water were 80.

9. The importance of getting out the last traces of water in gutta-percha and paper when used for cables.

(*To be continued.*)

A NEW INTERRUPTER FOR INDUCTION COILS.*

By V. CREMIEU.

In consequence of the working of the interrupters used in Ruhmkorff coils, the induced electromotive forces, of opposite nature, are not equal in absolute value; they may be represented by the curve (fig. 1) in which *e r* shows the electromotive force induced on the breakage of the primary

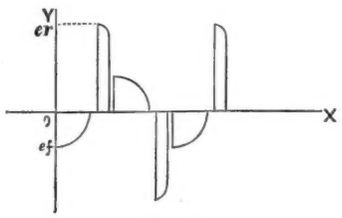


Fig. 1.

circuit and *e f* that which is induced on the closing of the circuit. This difference, which is considerable, is productive of much inconvenience in the use of induction coils.

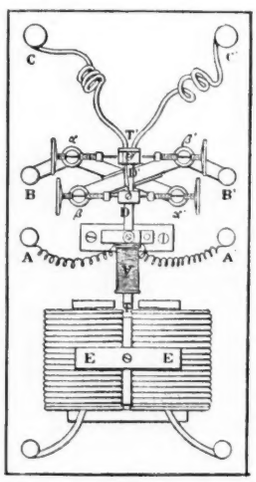


Fig. 2.

By sending into the electro-magnet an alternating current, we can, for low voltages, overcome this inconvenience; but this method cannot be used when we wish to obtain sparks several centimetres long.

I have solved the question by means of the little apparatus I am about to describe.

An electro-magnet E E′ is excited by an alternating current (fig. 2). Between its two poles oscillates the end of a rod T T′, movable at O, on an axis perpendicular to the plane of the figure. The part O T is of soft iron and the part O T′ of ebonite or some other insulating material. On the part O T is wound a little bobbin, V, traversed by a continuous current. From it we get at T a determinate magnetic pole. When the alternating current traverses E E′, an oscillatory movement is imparted to the rod T, the period of which is equal to that of the alternating current. On the part, O T′, of the oscillating rod are fixed two platinum plates, D D′, connected by two flexible wires with the terminals, C C′.

During the movement the two plates, D D′, come successively in contact with the terminals, $\alpha\ \beta$, $\alpha'\ \beta'$; these are connected two by two with the arrival terminals, B B′, of the inductive current; the arrangement of the apparatus shows therefore that if, for instance, the + pole of the current is at B, and the − pole at B′, the current which circulates between C and C′, in consequence of the successive closings of the current due to the movement of the rod, will go alternately from C to C′, and from C′ to C; the nature of the current between these two terminals will be reversed between two successive breaks. We see, therefore, that the induced electromotive forces of opposite nature (fig, 3) will,

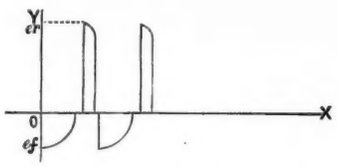


Fig. 3.

at each movement, be the sum of two quantities that are always the same, and of the same sign. They will therefore be equal in absolute value.

The apparatus works very well. For an intense inductive current, the contacts, $\alpha\ \alpha'$ and $\beta\ \beta'$, and the part O T′ of the rod should be immersed in some suitable liquid.

The only drawback which can, however, easily be provided against, is a somewhat considerable loss of energy; in order to obtain sparks of the same length, it is necessary to send into this interrupter a current of double the electromotive force required with a Foucault interrupter. The apparatus is, moreover, reversible, *i.e.*, if we connect the terminals C C′ with the two poles of the alternating current, a derivation

Fig. 4.

of which excites the magnet, E E′, we get between the terminals, B B′, a reversed alternating current. If the current arriving at C C′ is represented by the curve shown in fig. 4, that received between B B′ will be represented by the curve shown in fig. 5.

But we must avoid producing the successive breaks at the

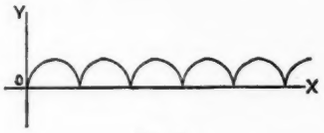


Fig. 5.

moment when the periodic electromotive force has its maximum value, or even a large fraction of this value.

A very simple arrangement enables us to produce the breaks at the moment when this electromotive force is *nil:* the screws of the contact terminals, $\alpha\ \alpha'$, $\beta\ \beta'$, are hollowed out in the direction of their axis, with a cylindrical cavity (fig. 6). At the bottom of this cavity is a very flexible spiral spring and a cylindrical piece of platinum, T P,

* Note presented to the Académie des Sciences, February 17th, 1898, and reproduced from *L'Electricien.*

in the form of a plunger, the rod of which, T, would slip into a brass screw cap, C, screwing on to the end of the screw.

The rod T T′ being at rest (fig 2), the four screws are regulated so that they touch, without pressing, the contacts

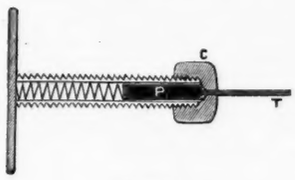


Fig. 6.

D D′, the end T being equidistant from the two poles of the magnet E E′.

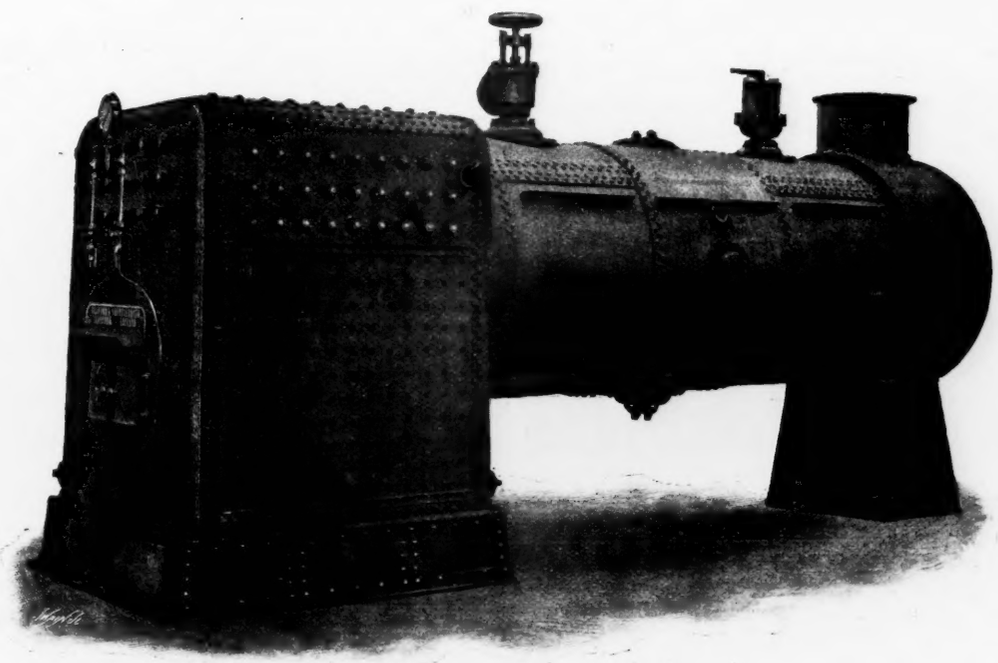
As soon as the rod T T′ oscillates, the contacts D D′ are drawn right and left, alternately repelling the plungers α β on leaving α' β', and then repelling α' β' on leaving α β.

If we observe, moreover, that the rod T T′ passes through its position of non-acceleration just at the moment when the electromotive force of the alternating current which excites E E′ is also *nil*, and that the breaks are made at this very moment, we see that there will be no break spark at α α, β' β'.

In practice, very feeble sparks are produced. The loss of energy does not exceed a quarter of the original energy.

BOILERS FOR CAPE TOWN ELECTRICITY WORKS.

Messrs. Clayton & Shuttleworth, of Lincoln, have supplied two large locomotive type boilers for the electricity works at Cape Town. These are of the type shown in the photograph and known as the "Belpaire." The boiler is constructed of mild steel throughout, and the fire-box plates are of a special quality in order to withstand high temperatures. The Belpaire type of boiler is claimed to offer great advantages in respect of the staying of the fire-box crown, as through stays can be used, which for large fire-boxes and high working pressures are thought to be better than girder stays, because they leave the top of the fire-box comparatively clear for cleaning purposes. There is also said to be a saving in weight. The scantlings on plates and stays are to suit the Board of Trade requirements for a working pressure of 150 lbs. per square inch. The extreme length of the boiler is 22 feet 6 inches, its width 6 feet, and the height, exclusive of ashpan and fittings, 7 feet 9 inches. The longitudinal seams are fitted with double butt strips, and all rivet holes are drilled in position. The main diameter of the barrel is 5 feet 6 inches. The barrel plates are $\frac{9}{16}$ inch thick. Front plate, throat plate, and fire-box casing $\frac{9}{16}$ inch. Tube plates $\frac{3}{4}$ inch, and the fire-box plates $\frac{9}{16}$ inch. The inside dimensions of fire-box are: Length, 6 feet $0\frac{9}{16}$ inch; width at top, 5 feet; width at bottom, 5 feet $3\frac{3}{4}$ inches; total depth, 5 feet $2\frac{1}{2}$ inches; depth to fire-bars, 4 feet $6\frac{1}{4}$ inches. There are 98 steel tubes in the boiler, each of 3 inches external diameter, 10 S.W.G. thick, and 12 feet $1\frac{1}{2}$ inch long between the tube plates. This includes six stay tubes, with nuts on each side of the tube plates. The total heating surface is 1,080 square feet, and the grate area 32·2 square feet. The guaranteed evaporative performance is 5,360 lbs. of water per hour. The manufacturers subjected the boiler to a hydraulic test pressure of 280 lbs. per square inch, and a steam pressure of 150 lbs. per square inch without any sign of leakage or any weakness.



AMERICAN TRACTION PLANT.

The *Street Railway Review* is grieved because an esteemed English contemporary expressed the opinion that there was a good field for British made electric traction plant in America. To send electric plant to America would savour of sending coals to Newcastle, says the *Street Railway Review* in its wrath, and it proceeds to give advice to Englishmen as to learning from American experience. We are not ourselves disposed to question the fact that American experience is very great in traction supplies manufacture. At the same time, we doubt altogether the conclusions drawn from the sale of American plant in England. In the first place,

while Americans are busily engaged in cutting each others throats, or rather prices, we observe that they all, with one accord, keep an eye on the topmost brick of the high tariff wall they have built around the domestic cockpit. Americans can beat the world: they declare this to be their conviction. At the same time, all the world can see they have not got the courage of their convictions, and whether they could do so or not, they dare not face the world except from behind the high wall. Wisely or unwisely, business on this side is conducted with some idea of profit, and either because of this or because we are too slow in adopting cheapening devices and machinery, we cannot afford to sell the equipment of a car, including two 25 H.P. motors and all accessories, for £140, which is, we believe, the price at which American plant is sold to England. We are not informed as to whether American manufacturers can make a profit on these rates, nor are we told whether these low prices are available for American purchasers. Wherever we have investigated the relative prices of American goods at home and in England we have invariably found that the prices for identical goods were very much less in England, and the conviction has forced itself on us that England has the chance of buying a good deal of stuff at less than it can be bought behind the tariff wall. All Queen Victoria Street speaks to this conclusion. Protective tariffs always produce these results. Another instance is that English sugar users pay less for sugar than its makers in France or Germany. It may be that the overflow of American manufactures is alone sold here at such low figures. Whatever the cause, it is certain that American goods are not able to compete in the open market, whereby we mean not the neutral market alone, but the home market also. Americans themselves do not yet believe in their ability to compete on fair terms, or they would knock a brick or two off their 50 per cent. wall of tariffs—or is it 75 per cent.? a few per cent. makes no difference, however—and come out into the open. While we English are certainly likely to purchase a good deal of bounty-fed sugar and tariff-cheapened machinery for some time, we cannot agree with the *Street Railway Review*, that American factories can give us as good and enduring apparatus as we are likely to evolve at home. It is not as our contemporary supposes, a question of conditions, nor is it that English engineers decry American experience.

With an equal amount of experience, we venture to say that English traction plant will surpass that of American make. At present we have not the experience, and Americans take very good care that we shall not gain that experience by manufacturing for them. Our contemporary would retort that they know better than buy from such inexperienced people. We anticipate the retort, and would reply that they dare not give us the chance of selling, nor dare they offer their own public the chance of buying.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by **W. P. Thompson & Co.**, *Electrical Patent Agents*, **322**, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

8,489. "Improvements relating to the electro-deposition of metal." H. W. Wright. Dated April 12th.

8,495. "Improvements in electric switches and fuses" J. McFarlane and Holland House Electrical Manufacturing Company, Limited Dated April 12th.

8,528. "Process and apparatus for concentrating magnetic iron ores and bricking the same for market." B. J. B. Mills. (T. A. Edison, United States) Dated April 12th. (*Complete.*)

8,539. "Improvements in and relating to electric heaters." E. F. Porter. Dated April 12th. (*Complete.*)

8,550. "Improvements in automatic magnetic circuit breakers." W. M. Scott. Dated April 12th. (*Complete.*)

8,584. "An automatic switch for electric cooking utensils." F. J. Down and J. Eck. Dated April 13th.

8,602. "Barriers for the outside entrance of tramway, electric tramway and railway carriages." C. Lindner. Dated April 13th.

8,603. "Waterproof contact apparatus for electric railways with underground conductor." G. Ihle. Dated April 13th. (*Complete.*)

8,638. "Improvements in electric furnaces for the manufacture of carbide of calcium or other electro-chemical or electro-metallurgical products of the like kind." P. Determes. Dated April 13th.

8,645. "Improvements in telephone directories." J. D. Browning. Dated April 13th. (*Complete.*)

8,710. "Improvements in and relating to electrical incandescence lamps." J. R. Quain. Dated April 14th.

8,713. "Improvements in and connected with generators for electrical igniters in gas or like engines." B. McInnerney. Dated April 14th. (*Complete.*)

8,718. "Improvements in telephonic apparatus." M. Freudenberg. Dated April 14th.

8,735. "Improvements in telegraphic transmission over long submarine cables by Wheatstone's automatic apparatus." S. Roos and P. Biraghi. Dated April 14th.

8,823. "Improvements in or connected with drum apparatus for electric generators and motors." V. A. Fynn. Dated April 15th.

8,829. "An improved apparatus for counting telephonic conversations." F. Graf. Dated April 15th.

8,832. "Improvements in electricity meters." C. E. O'Keenan. Dated April 15th.

8,848. "Improvements in the method of and means for the electrical propulsion of railway, tramway and other similar vehicles." W. G. Heys. (J. J. Heilmann, France.) Dated April 16th. (*Complete.*)

8,856. "An improved method of intercepting dust arising from the commutator of dynamos." J. McLaren. Dated April 16th.

8,864. "Improvements in electric devices for theatrical purposes." M. Sanson. Dated April 16th. (*Complete.*)

8,901. "Improvements in or relating to electrostatic machines." L. S. A. Cohendet & Co., and P. Archat. Dated April 16th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 5th being date of application in France).

8,913. "A method of and means for transmitting electric currents through musical instruments to players or performers." H. B. Knoblauch. Dated April 16th.

8,920. "Improvements in trolley poles and standards for electric traction." Siemens Brothers & Co., Ltd, and F. Ayton. Dated April 16th.

8,927. "Improvements in electrical apparatus for gas lighting and other purposes." J. F. Bennett and W. Appleyard. Dated April 16th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of **Messrs. W. P. Thompson & Co., 322, High Holborn, W.C.**, *price, post free*, **9d.** *(in stamps).*]

1897.

5,136. "Improved electric tan bark bath and apparatus therefor." J. J. Stanger. Dated October 9th, 1897. This relates to an improved tan bath for use against rheumatism, gout, &c. There is a bath filled with tannin solution, to which the electric current is supplied, so that the main conductor is in connection with the electrodes. These electrodes are carbon and do not contaminate the tannin solution. They are inserted in slotted wood frames placed in bath, and are easily removable. Upon a plate there are placed a rheostat, a reversing switch, a current meter, and a bell in such a manner that these apparatuses which control the current at will are easily accessible from the bath. 3 claims.

4,183. "Improvements in electric incandescent lamps." C. S. Dolley, R. Hawkins, T. M. Lightfoot, H. P. Goodwin. Dated October 16th, 1897. This consists of an electric lamp, which has an incandescent filament compressed between two non-conducting plates of mica one or both of them being transparent. The air has been exhausted from between these plates, which are set in a hermetically sealed boundary frame. The carbon conductor is furnished with platinum wire connections. 3 claims.

9,173. "An electro-therapeutical lamp." R. I. Mayer. Dated October 16th, 1897. This consists of a handle, on end of which there is filled an incandescence lamp within a suitably arranged reflector, through the core of the handle pass the conductors. 1 claim.

19,035. "Improvements in electrolytic apparatus." H. Sefton-Jones. (A communication from E. Balbach.) Dated October 16th, 1897. This consists of a cathode case composed of a trough having its bottom divided in two portions, one of which is horizontal. The other portion sloping down and connecting the horizontal portion throughout its length. It is provided with a cathode plate and an anode suspended therein, arranged to cover the horizontal portion of the bottom only. The anode case is composed of an exterior frame which has a grated bottom, and an inner frame fitting into the exterior case, with a filter cloth bottom. Instead of one anode case there may be a series, arranged transversely side by side. 5 claims.

20,041 "Improvements in metal for telegraph and other poles." G. W. Glazier. Dated October 16th, 1897. This consists of a pole to the end of which is secured segmental metal base sections by means of bolts; the lower ends of these sections are made outwardly flaring, and are provided with a series of perforations through which the earth is rammed after these sections have been placed in a cavity in the ground. On the outside of these sections are strengthening ribs which, besides serving to increase the strength, also in a measure conceal and protect the heads and nuts of the fastening bolts. 2 claims.